The Electrical World.

VOL. XXIV. NEW YORK, SEPTEMBER 1, 1894. No. 9.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the U. S., Canada or Mexico; other Postal Union countries, $6.

In requesting your address changed give OLD as well as new address.

Established 20 years ago, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the Largest Circulation of any electrical periodical in the world, and is the best Advertising Medium.

"WANT" AND "FOR SALE" ADVERTISEMENTS

are a special feature of THE ELECTRICAL WORLD. Position Wanted small advertisements cost but $1 an insertion; Help Wanted and For Sale small advertisements cost but $1.50 an insertion. Remit in advance for the number of insertions desired.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXIV. NEW YORK, SEPTEMBER 1, 1894. No. 9.

CONTENTS.

Editorial 191
The Business Situation 193
Tesla Effects with Simple Apparatus, by H. M. Martin and W. H. Palmer, Jr., ... 198
Electricity in Church 199
American Association for the Advancement of Science . . 202
Oxford Meeting of British Association 204
Dynamo—Electric Machinery, by E. J. Houston and A. E. Kennelly. 205
Electric Lighting in Great Britain—III., by E. Ray Stevens . 206
Mail Service by Trolley 207
Some Advantages of Alternating Currents, by S. P. Thompson . 208
Electrical Engineering Education 209
Practical Notes on Dynamo Calculation—XV., by Alfred E. Wiener 210
Sine Forms of Curves of Alternating E. M. F. by Louis Bell . 211
Digest of Current Technical Electrical Literature, Compiled by Carl Hering 212
Modern Telephone Exchange Practice, by J. E. Keelyn . . 214
The Western Electric Company Enters the Railway Field . . 214
Recording Meter 214
Standard Trolley and Trolley Wheel 215
Large Capacity Switch 215
Mechanically Operated Bells 216
Heater, Purifier and Receiver 216
Electricity in Mining 216
Direct Connected Generator 217
Trolley, Harp and Wheel 218
Combination Windlass 218
A New Knife Switch 218
A New Incandescent Arc Lamp 218
The Johnston Rail Bond 219
Electric Door Opener 220
New National Dynamo 220

DEPARTMENTS:
Financial Intelligence 221
Special Correspondence 221
News of the Week 223
Trade and Industrial Notes 224
Business Notes 225
Illustrated Record of Electrical Patents 226

THE BUSINESS SITUATION.

Elsewhere we print a collection of views on the business situation, contributed by the leading members of the electrical industry, which is a most complete canvass of the field. The reader will find only encouragement in the opinions expressed, and doubtless will also be favorably impressed by the conservative tone everywhere noticeable, which offers such a strong contrast to the extravagant views bred of the speculative spirit of a few years ago. Taken in connection with the general revival of business throughout the country, the conclusion is abundantly justified that we are once more on the high road to prosperity, and that each succeeding month will add to the impetus, even now so strongly apparent. Still another expression of this general confidence is the volume of advertising in this issue, which reaches that of some of the special Convention issues in extent.

THE NEW TARIFF BILL.

We give elsewhere an account of the changes in the new tariff bill which have a bearing on the electrical industries. From this it will be seen that, aside possibly from the iron schedule and incandescent lamps, its influence on electrical business will be only an indirect one. Those most interested in the question hesitate to express an opinion at this early date as to any probable effect in the cases that may involve foreign competition, preferring to await the interpretation to be placed by the Treasury Department on doubtful points, and ascertain if a readjustment of domestic prices may not obviate foreign competition. The thirty per cent. reduction of duty on the kind of iron and steel plates used for armature discs may lead to more orders for these being placed abroad, for they have been imported even under the present rate of duty. This same remark might also apply to iron and steel castings and forgings for generators and motors. The reduction of the duty paid by the class of articles among which incandescent lamps have somewhat illogically been included, is very considerable—from 60 per cent. to 35 per cent.—and at present prices abroad would enable foreign manufacturers' agents to sell lamps in New York dangerously near American prices. Whether such lamps could compete in quality with our own is less open to question, the advantage lying with American lamps if we are to judge from the published results of tests.

REACTANCE.

One of our English contemporaries severely criticises Prof. S. P. Thompson for a misuse of the term "reactance," but in so doing itself falls into error. Prof. Thompson, in a paper read before the British Association, used "reactance" where "impedance" was the proper term, but until we read the criticism referred to we thought that there could be no doubt but that this error was merely due to carelessness or haste in writing, and are still inclined to retain that opinion. In the criticism, however, an error that cannot be thus excused is contained in the statement that "reactance is only that term in the impedence expression which is due to magnetic induction." The reactance of a circuit not only includes the effect of induction, but also of capacity, and has been defined as the reactive E. M. F. of self or mutual induction, capacity and other counter E. M. F. in the circuit, divided by the current, which is the meaning authoritatively accepted in America. The value of the term consists in differentiating the factors of the apparent resistance of a circuit that do not require the expenditure of energy to overcome them, from the ohmic or true resistance, which does involve the expenditure of energy. We may here remark that while, as our contemporary intimates, the origin of the term "re-

actance" is due to Heaviside, its practical introduction has resulted largely from the advocacy of Prof. Hospitalier—a fact which should have been more generally recognized than it has.

SIGNALLING THROUGH SPACE.

A paper with the above title was read by Mr. W. H. Preece before the Oxford meeting of the British Association, in which, as far as we can determine, there is little or no matter of importance, beyond a reference to resonance effects, that is not contained in a paper entitled "On the Transmission of Electric Signals Through Space," which was read by him before the Chicago International Electrical Congress and reprinted in the Electrical World of September 2, 1893. All of our readers are doubtless acquainted with the induction system of telegraphy to and from railway trains in motion. As far as we can see, the work of Mr. Preece has been merely to extend the distance over which this system can be operated, using, however, alternating currents of high frequency and employing the telephone for a receiver, which are most obvious changes. Both papers are clearly composite in their character, consisting of descriptions of empirical experiments and a scientific dressing apparently added with a view to giving the whole the appearance of a learned contribution, for it does not appear that the experiments were either guided by the many theoretical considerations brought forward or furnished any deductive grounds for their presence in the paper. In a recent experiment with two grounded parallel lines, each two miles long and four miles apart, it was found possible to transmit signals, but we cannot see that this proves, as stated, that similarly "we could readily communicate between England and France, or between outlying islands and the shore, when the conditions admit of the erection of the necessary circuits" though the qualifying clause renders the promise contained in the statement rather ambiguous and perhaps safe. Mr. Preece says that "a somewhat fascinating branch of this subject is the possibility of signalling across planetary space"; Mr. Maxim might similarly say that a fascinating branch of aeronautics is the possibility of traversing planetary space.

ENGINEERING EDUCATION.

The second annual meeting in Brooklyn last week of the Society for the Promotion of Engineering Education showed no abatement of the interest that marked the first meeting, held in Chicago last year. Besides the usual object of such bodies, which is to act as professional centers and to encourage the reading of papers, the present one also aims to arrive through its labors at a definite standard in engineering education and its methods. Owing to the chaotic condition of ideas—or perhaps it would be more correct to say, lack of ideas—in regard to such a standard, it will require a considerable interchange of views before the more important points will be differentiated, and the numerous papers thus far read should largely contribute to this end. It would seem desirable, however, to make some tentative declaration of principles in order to concentrate discussion, and while it may as yet be too soon to adopt this course, the best results cannot be achieved until it is done. First and most important is to decide as to what the education of the engineer should be, for until this is done there is little profit in writing of methods. What this education should be in turn depends upon the career the graduate is to follow, and the final solution will have to be in accordance with the requirements of this object. Much of the difference of opinion in regard to engineering education rests upon the different ideas held as to the subsequent career of the graduate. With some the main object is held to be the equipment of the mind of the student with principles, details being left to be learned during the apprenticeship which the graduate is naturally expected to undergo in the first years after leaving school. At the other extreme are those whose whole aim is to develop the wage-earning properties of the student, so that he can at once upon graduation enter into comparatively remunerative employment, the teaching of principles in this case being necessarily sacrificed to the teaching of details and manual dexterity. Between these are all gradations of views, and there does not seem to be any hope of any agreement as to the methods of education until some understanding is arrived at as to the ultimate object. The solution seems to be in a distinct division of engineering courses after the method followed in France. There we find three classes of schools which in most cases in this country are attempted to be combined in one curriculum. There we find separate schools for the education of the engineer who intends to practice the higher parts of the profession; also for those whose aim does not extend beyond the superintendency of a plant or other large establishment, and finally for those whose object is to become experts in the processes of an industry.

THE REVIVAL OF BUSINESS.

The long deferred passage of the tariff bill at last relieves the business interests of the country of an incubus which has been most depressing in its influence, and the numerous comments we print elsewhere as to the consequent effect in the electrical field are most encouraging. Of all the industries the electrical ones should find most hope under the new conditions, for now it will be possible to realize the many hundreds of projects which our news columns have noted during the last year, particularly in relation to electric railways, and to again resume the great march of progress recently brought to an almost complete halt. General Electric stock, which has recently been quoted as high as 46, is an illustration of the buoyant effect which began to manifest itself several weeks ago in anticipation of the passage of the tariff bill, the quotations previously having held around 36. That this effect has been pretty general in its extent is shown by the evidence we have gathered from many localities and many different branches of electrical and allied business interests. This is only natural, for it would be unreasonable to suppose that the previous great expansion of electrical business has received any permanent check by the depressing influences of the past year. At no period has its course, aside from promotion schemes, been an unhealthy one. Its prosperity has resulted from a natural demand springing from a recognition of the real economic advantages which its applications offer. With trade again in a normal state and these conditions unchanged, as they are, one need not be sanguine to expect a return to a state of prosperity which, though lacking the former flashy elements, will be none the less real. Some lessons have been taught that will have, it is hoped, a good effect in the future, and the experience of the past year will almost undoubtedly result in imparting a more business-like method to the conduct of electrical affairs. Owing partly to the rapid expansion of the industry and partly to a great influx of those unskilled in commercial affairs, much of the profit that otherwise might have been gained in former days was lost by unwise competition, and by too much reliance on the profits of the future and not enough attention to those of the present. The sore trial just ending has taught the stern necessity of looking out for details and not trusting to the future for too much aid in repairing the omissions of the present. The mischievous phrase about electricity in its infancy, which has been responsible for so much injury of this nature, is beginning to be discredited, and it would be well if it could also be left behind along with the other ills of the past year. If it should regain its old potency with returning prosperity, the result would be another stampede for the electrical field, more unhealthy promotion schemes and the derangement of the adjustments, so necessary for real commercial prosperity, that naturally result from the competition of novices, who themselves do not secure the profits which they divert from legitimate trade channels. With, therefore, the field cleared of much rubbish, better commercial ideas inculcated, and an industry based upon a healthy and expanding basis, there is every prospect of a near and prosperous revival of electrical business, and of a progressive extension that will be the more secure from lacking the abnormal elements of the past.

We give below a collection of opinions on the probable effect on the electrical industry of the passage of the tariff bill and on the general prospects for the future. The views expressed are those of representative men in every department of electrical business and from almost every section of the country, and form, therefore, an authoritative estimate of the situation.

E. I. GARFIELD, New England manager of the Ft. Wayne Electric Corporation, Boston: "Certainty is better than uncertainty. While the tariff bill is not satisfactory to the party in power, or to the country, it is far better than no action at all. Manufacturers now know where they are, for they have a certainty where before all was uncertainty. As a result, confidence will be restored and business will improve in all branches, but especially in industrials, and that includes electrics. Improvement will be slow, for it is impossible to recover from the effects of the panic in a month, or even a year."

Z. CHAFEE, president of the Builders' Iron Foundry, Providence, R. I.: "We consider that the effect will be beneficial. All lines of business will adjust themselves to the new conditions and prosperity will gradually return. The electrical industries will probably be among the first to feel the improvement."

ELBERT WHEELER, treasurer of the Wheeler Reflector Company, Boston: "We confidently expect a gradual and steady improvement over the conditions of the past year, and that legitimate enterprise will hereafter prosper. Our national prayer should now be: 'More business and less politics.'"

W. G. CHASE, treasurer of the Mason Regulator Company, Boston: "I do not look for any sudden revival of business. I think that this coming fall will show an increase over the business of last fall, but only in a moderate degree. It seems, from all indications, as if it would take a year at least for that class of manufacturers which we represent to resume their normal condition, and I do not share the views of many people who imagine that almost from the moment of the settlement of the tariff question, a sudden boom in all industries will take place."

E. C. HUXLEY, president of the American Tool & Machine Company, Boston: "Without entering into the merits or demerits of the tariff bill which has recently passed Congress, I have no objection to saying that the final disposition and settlement of the bill will doubtless tend to increase business as a whole, and, although I do not look for a great boom in trade, there will doubtless be a steady and healthful growth."

D. A. ANDREWS, JR., of the Pettingell-Andrews Co. Boston: "In my opinion any settlement of the tariff question by Congress will help the electrical business, as it willhelp all other branches, by giving a feeling of confidence that has been lacking since the present administration came into power. I do not think the special form of the bill is so important to our branch of the business as the return of business confidence."

N. MARSHAL, manager of the Iona Manufacturing Company, Boston: "We are pleased to state that there appears to be a slow, though unmistakeable improvement in our business, the volume for July, which is our dullest month, being very considerably over that of a year ago, and our August business so far has shown fully one-third above the same month last year, with less favors granted to buyers. While we do not look for a boom in our line of trade, we are making preparations to do a fair volume of business the coming fall, and shall be very much mistaken if there is not very considerable improvement from now on."

A. A. ZIEGLER, president and general manager of the Ziegler Electric Company, Boston: "We manufacture to quite an extent instruments and apparatus for educational and scientific purposes, and the highly cherished protection of American labor has not come to our assistance either under the old or the new tariff. A little more free raw material would, therefore, have been one of our wishes. Taken as a whole, we believe that the new law is an improvement on the old one and a step in the right direction, and that it will influence business favorably."

F. FOSDICK, president of the Fitchburg Steam Engine Company, Fitchburg, Mass.: "We believe that *any* settlement of the tariff question will be better for the present business than the unsettled condition which has prevailed, and that there will be a revival of business as soon as it is certain what is to be the final disposition of the mongrel tariff bill. It will inevitably, if it becomes a law, result in a reduction of wages in our view, as the classes of business not so directly affected by the changes in the tariff will be no less indirectly affected because of the necessary reduction in price of goo ls in other classes of business, occasioned by competition with cheap foreign labor. A reduction of wages means a reduction of the purchasing capacity, and therefore a reduction in demand upon the manufacturers. This, with increased importations, will doubtless affect all business, and we do not anticipate any such increase as would have been ours if the present tariff laws had been let alone."

H. N. FENNER, treasurer of the New England Butt Company, Providence, R. I.: "I agree with the many others who have expressed themselves on the subject, that notwithstanding the provisions of the bill the settlement of the question will bring renewed prosperity to us all."

W. E. SESSIONS, manager of the Sessions Foundry Company, Bristol, Conn.: "We think there is a little improvement in business generally and the prospect is for a gradual improvement, but not for any great change, in the next few months at least, unless the President should veto the tariff bill. We fully believe that if he should do so business would speedily improve."

C. E. BILLINGS, president and general manager of the Billings & Spencer Company, Hartford, Conn.: "While we are not wholly satisfied with the result of the tariff question, we believe now that it is settled that business will generally improve, not only in the electrical field, but in all other lines."

R. F. BLODGETT, secretary of the Pratt & Whitney Company, Hartford, Conn.: "As we are not properly in the electrical trade, we have some doubt about the propriety of expressing our opinions upon the electrical industry during the ensuing fall and winter. We do not wish to assume any gifts of prophecy, and would prefer not to say what we think may be the course of business in our line. We anticipate little improvement for several months, but feel confident that we will do more business from September 1 to December 31, 1894, than we did in the same months in 1893. Our order books for several months have looked well."

T. C. PERKINS, vice-president of The Mather Electric Company, New York and Manchester, Conn.: "As to the prospect of the general improvement in business, we are glad to state that recently and since the practical settlement of the tariff matter at Washington, we have experienced a very marked and healthy improvement in our business. Our business has even increased much more rapidly than we anticipated, and we look for a continued improvement hereafter."

W. C. BRYANT, treasurer and manager of the Bryant Electric Company, Bridgeport, Conn.: "It is a little early as yet to predict, but it seems to me that as most of the dealers and consumers have carried very little or practically no stock for the last year, as trade increases the manufacturers are certain to be very busy. If the tariff uncertainty is settled within another week, as it now looks as if it would be, I think we may reasonably expect a prosperous fall for the electrical trade in general, debarring the one fact that prices are low and we have got to do a larger volume of business to get a fair profit."

H. L. LUFKIN, manager of the Crocker-Wheeler Electric Company, New York: "The outlook for business, particularly of electrical power transmission in the mills and factories, is especially promising. The one unfortunate feature, however, is

the fact that in the severe struggle to secure business during the present period of depression, prices have been so slaughtered as to leave little or no margin of manufacturing profit. Conditions of this kind are too apt to lead to the production by the manufacturer of inferior apparatus, or of the sale of apparatus which is more or less overrated in capacity, as the case may be. It is perhaps unfortunate that dynamos and motors have no commercial rating by which their capacity can be readily and accurately determined by the prospective purchaser, as is the case with a steam engine. Had we a rating of this character, I am inclined to think that there would not be the vast differences which are now sometimes found in a set of bids, apparently made on similar specifications, and it would help in a degree to straighten out the matter of prices on apparatus, and be in general of great value to the trade."

E. W. Little, vice-president and general manager of the Interior Conduit and Insulation Company, New York: "We manufacture electrical specialties, the patents of which are controlled by our company both here and abroad, so that we have not felt the prevailing dullness from the tariff squabble as much as the other lines of trade. Of course, we are glad the question is settled as we think people will now buy more than they have been. Though our trade so far for 1894 does not show as great a percentage of increase as it has the last two or three years, business is fairly good, with the prospect of it being much better."

T. J. Smith, manager of The E. S. Greeley & Company, New York: "Our South American trade has been the steadiest and most remunerative part of our business during these dull times. The local trade has been provokingly stagnant for over a year, though we think even so that our sales have been twenty-five per cent. above other supply houses. Though the present tariff will not affect us directly, I do not look for prosperous times until trade and wages are regulated to the conditions of the tariff schedule. In the end there may be a benefit, but I hardly think the electrical supply trade will reach the proportions it did two years ago."

J. E. Ham, general agent of W. R. Brixey, New York: "Our factory has been running full time so far this year, though our orders have been curtailed somewhat on account of the tariff dilatoriness. Now that it is over with we hope for better times."

J. J. Gorman, of the Manhattan Electric Supply Company, New York: "It is too soon for the passage of the tariff bill to have any material effect on our business, but we do look now to better times with the revival of trade which is sure to come. As far as tariff duties are concerned, they do not bother us particularly. We have had the best months during May, June and July this year than we have had since our business was started, and it looks now as if the volume of trade for August will be up to the standard of those prosperous months. It is still pretty hard work to make collections, but these are far easier than they were a year ago."

W. P. Jones, secretary of the Law Battery Company, New York: "Irrespective of what is embodied in the Congressional bill before the President for approval, we believe that, if it secures his signature, or is permitted to become a law *per se*, the state of uncertainty that has pervaded the business world in general for a long time past will immediately give way to a feeling of confidence to the extent at least of inducing the circulation of much of the money that has been kept in a state of innocuous desuetude awaiting some definite action by our legislators. Now, if—and the if here is a very important factor—we incline toward the sentiments of a large number of our friends, this assures commercial activity to the business world in general during the fall and winter; on the other hand, if we voice these sentiments of many others, this will hold good only with a select few. Being thus situated between two fires, we are inclined to believe that the time is not yet ripe enough to give a satisfactory answer to your first question. Turning to our own field, we should say, taking our own experience for a basis, that a revival of trade has already commenced; and that if the handlers and consumers of electrical goods who have a propensity to look at cheapness rather than quality will only see the error of their ways, reverse their views and thereby permit contentment to enter the homes of the working men, the manufacturers will then be enabled to live up to the motto, 'A true workman is worthy of his hire,' the revival will be permanent—permanent, at least, for a long time ahead. The law of supply and demand is a factor that cannot, of course, be ignored, but in a country like ours the vintage is large and the harvest consequently in proportion."

Chas. D. Shain, New York: "The slight change in the tariff schedule will not, in my opinion, practically affect the electrical business in any way. The passing of the new tariff bill and the settling of the question which has been hanging fire so long, will, no doubt, give business generally an impetus and the electrical trades will of course benefit thereby. In the past years there has been so much illegitimate financeering in the electrical business, causing an unwarranted growth, that it will, in my opinion, take some time to get back to conditions existing before the panic. Undoubtedly the electrical business has a great future before it, but it must and will become a legitimate business and the quicker it does so the better it will be for every one concerned in the trade. I am inclined to believe the hard times have been a benefit in disguise to our industry and look forward to the future as one of solid growth."

Frank M. Pierce, president of the Pierce & Miller Engineering Company, New York: "It is our opinion that there will be a marked, though temporary, improvement in business, due to the passage of the tariff bill, not because the bill in itself is not antagonistic to general business interests, but because a settlement of the question, one way or the other, enables business men to discount the future with some degree of certainty, and arrange their business accordingly."

Thos. C. Wood, president of the Ball & Wood Company, New York: "All through this depression there has run an undercurrent of demand and supply sufficient to keep alive most of our industries not directly affected by tariff legislation. In our own line of manufacture not only has our entire force been employed, except during a few months late in 1893 and early in the present year, but since May 1st our night gang has been regularly at work. The time has gone by when a manufacturer can build engines for stock, especially for the electrical industry; each order has its own special features, specified by the consulting engineer in the case, and as all of these require changes in patterns and design and take time to accomplish, the delivery of orders is spread over a longer period and changes in the general business conditions are less abruptly felt. It has been astonishing all through the panic to find, on looking over the files of your paper, the number of new railroads and new lighting plants projected, or plans contemplated for extensions and betterments in old ones. If there has not been sufficient to keep us all at work, it has had the effect at any rate of causing those who were dull to see the necessity of broadening their markets and of making an effort to obtain a share of foreign trade which Americans have always been too slow to prosecute. As to the passage of the tariff bill and the effect it will have on business, it cannot fail to be good, and the further adjournment of Congress will remove the uneasiness the business world always feels when it is in session. It seems likely that further tariff tinkering will be done piecemeal, regardless of what party is in power, and that politicians will be wary about again taking up any wholesale revision for a long time in the face of our recent experience. Our money seems to be fixed as honest, and in the field of labor the air too has cleared. With all of these facts in view the course of business must be upward, and if slowly upward then all the better. I look, therefore, for gradual improvement in business, though it will be many months, I fear, before prices regain their lost ground or labor will be as highly paid as in the past."

Jas. L. Robertson, Jr., president and general manager of the Hine & Robertson Company, New York: "We look for a gradual improvement in business from now on, unless our imports should reach such a figure that our good resources will be taxed to an extent to create alarm and uncertainty among moneyed men and institutions to whom we must look for assistance in building up our crippled industries. We certainly hope such will not be the case."

Geo. L. Colgate, president of the Geo. L. Colgate Company, New York: "Having recently completed an extended trip West and South, I am able to speak regarding business prospects from more than local experience. There is not a shadow of doubt as to the immediate awakening of business activity and of a conservative continuance of good business. Very shortly 'depression' will be past history, and we will feel the vibration of the movement of business that has been bottled up, as it were, by ultra-conservatism and tariff tinkering."

J. H. Vail, president and engineer of the Electrical and Mechanical Engineering and Trading Company, New York: "It should not be overlooked that the effect of the new tariff bill upon many departments of industry is purely guess work and that experience only will determine the benefits or disadvantages accruing. We do not anticipate any immediate 'boom' but rather a gradual recovery from conditions of extraordinary depression. Electrical industries have had a more severe set-back during the period of financial depression than almost any other line of business. We believe that

the reasons for this are that many 'wild-cat' electrical enterprises have been invested in by a confiding public without a proper knowledge on the part of the investor, or a conscientious regard as to their real value as dividend earners on the part of the promoters. The proof of this is abundantly shown in the annual reports of electrical companies, in one of which we find several millions of dollars worth of securities written off at a nominal value. The commercial electrical business must be brought down to, and maintained upon, a legitimate basis: that is to say, the capitalization and actual investment should be limited to the real necessities of the case. Let the promoters of such enterprises be satisfied with actual profits earned by an operating concern in preference to swelling the enterprise at the outset with a large amount of watered stock of fictitious value."

J. H. SEYMOUR, president of the Clark Electric Company, New York: "The various causes which have brought the severe conditions of business in general are passing away, but it will take a little time to restore the conditions of four years ago. We must date the beginning of the business troubles from the financial embarrassment of the great banking house of Baring Brothers, in 1890, which caused a severe shock to financial confidence the world over, and especially to this country. The beginning of loss of confidence has been intensified by political legislation by Congress, and, in addition, by the unsound business methods in every branch of industry brought on by over-trading and speculation schemes. In regard to the electrical industry for the future, it seems to me that it never had a better prospect. The volume of our business may not be as great as we would like it this fall and winter, but it will increase rapidly in a short time, for the reason that the American people have great confidence in the possibilities of electricity."

W. J. CLARK, general manager of the railway department of the General Electric Company, New York: "Within the last few months our business has shown a remarkable improvement, and now that this tariff muddle is settled, I believe we will soon do as large, if not a larger, business than we have ever done since the organization of the General Electric Company. During a recent extended trip throughout the West and South, I was greatly impressed with the determination of the people there to throw off the prevailing depression and to get to work on a profitable basis again. The South and West have been the most discouraging fields for all kinds of electrical construction for over a year. The work there has been so light that it might be counted as nothing. There is now every indication that electrical buying from these sections of the country will, before long, be what it was two years ago. One of the most cheerful signs of the revival of trade is the increasing number of small orders we are receiving for our apparatus. While we look upon big orders as a sheet anchor, and, of course, necessary to our existence, the real barometer of business conditions is the number of minor contracts from all sections of the country. Heavy capitalized concerns purchase large quantities of supplies when prices are low, no matter whether the goods are absolutely needed or not. But small firms cannot do this. For over a year these small companies have been buying from hand to mouth, and patching wherever possible. Now they are coming to the front with orders and that shows that the people are getting over their scare, and are alive to the fact that money can still be made in this country. I see no reason why electrical industries should not have a tolerably active and profitable winter."

R. B. COREY, manager of the Electric Construction and Supply Company, New York: "It is plain that the electrical industry will be benefited by the settling of the tariff question. The electrical business, like other lines of trade, is dependent largely for prosperous times upon the general condition of affairs. Now if people build more and buy more, it, of course, quickens the pulse of the electrical industries, and there is every indication that the public are getting over their timidity to enter trade, and will now come out in force. Already we see an improvement in orders since the passage of the bill, and even if people are acting mainly from sentiment it is a change for the better. It now seems to me that we will have a steadily increasing fall and winter trade, and a very profitable business next spring. If crops are good next year we ought to have a veritable boom in electrical industries in the fall of 1895. These hard times have taught American manufacturers one good lesson. They have learned how to manufacture at a less cost during the last year and a half than they have been doing during the preceding ten years. The dullness has forced them to make labor saving improvements and reduce unnecessary executive expenses, so that manufacturing is now down to a thoroughly economical basis. We can easily compete with any nation in the production of electrical apparatus, and I have no fears from any low tariff schedule. The tariff that brings the greatest prosperity to the greatest number is the one for the electrical business."

G. N. MCKIBBIN, of Reed & McKibbin, New York: "The tariff question has not bothered us much, as electric railways are something it cannot directly affect. Naturally we are glad the uncertainty is ended, as people will now show more courage and forget past troubles. An era of trade and commerce will make a demand for more electric railways, and we look to busy times in this class of work during the next two years. We can say that so far as we are concerned, the past year has been a good one in electric railway construction. The season is about over with now, though we are still negotiating on the building of several fair-sized roads. As our work is confined strictly to the Eastern section of the country, it accounts for our doing so well, as Western electric railway building has been practically dead during the past year."

H. B. CHEEVER, manager of the Okonite Company, New York: "Our trade this year has been similar to that of 1893. While as yet there has been no extension in our trade, business is fairly good. Last year we had some bother in obtaining money for our pay-roll, while this year money is plentiful. We have never known such low money rates since the establishment of the Okonite Company. Bankers really ask us for our paper. While the present tariff will undoubtedly ultimately benefit trade, I do not look to great improvement for a year or more."

R. L. SHAINWALD, president of the Standard Paint Company, New York: "We expect the present tariff will be a benefit to all industrial circles. People want to get to work, and now that the vexed question is settled, every one will pitch in and try to retrieve some of the losses they have suffered for the last two years. We anticipate a moderately good winter trade, with old-fashioned prosperity later on."

JAS. P. MCQUAIDE, secretary and treasurer of the National Conduit Manufacturing Company, New York: "I have just returned from an extended trip through the West, and I must say that I have never known of so much business in our line contemplated for the immediate future. There seems to be, though, rather a feeling of uncertainty and the work is delayed until the last hour on that account.

P. H. KOBBE, treasurer of the Westinghouse Electric & Manufacturing Company, New York: "So far as we are concerned we have not bothered our heads any about tariff bills, as our factory has been crowded to its full capacity, so as to fill all of the orders for the present year. If the rest of the business community is benfited by the present tariff bill, we expect to get our share of the increasing trade. It is a little early yet for manufacturers of heavy electric machinery to feel any better state of affairs from the tariff change, so that we cannot say that we have received a larger proportion of orders since the passage of the bill. But when the rushing business does come we expect to be ready for it in the completion of our new works at Brinton."

J. W. GODFREY, general manager of the New York Insulated Wire Co., New York: "Owing to our line of goods we have not suffered much from the tariff wrangle and our business is in good shape. Money is easier, collections are fair and by our exercising greater caution we have a better class of customers than we had a year ago. Prices are down to ridiculously low figures. I think American manufacturers have cut them down lower than was necessary, for at present rates it is almost impossible to realize any profit. With the tariff nightmare out of sight the downward tendency of prices may be checked, but I do not look for any appreciation for a long period. Our present volume of business nearly equals the high water mark of 1892, and the outlook is favorable for increasing trade. There is no doubt to my mind that the electrical industries are to-day on a firmer, more substantial basis than they have ever been before, the business is past being a novelty with novel prices. A few years ago manufacturers could get fancy figures for their productions, as the goods were new and people were willing to pay high rates for the then limited supply. Now electrical apparatus and appliances have become staple wares, and the industry has gained the stability which comes with the trading in an indispensable standard line of goods."

W. F. D. CRANE, of the H. W. Johns Mfg. Co., New York: "If the tariff bill is beneficial, and in all probability it is, I think our trade will soon increase to the amount it was in the best days of two years ago. We have had a first rate year so far and have held our own, considering the prevailing dullness, far beyond our

expectations. There is a better tone in the market since the new tariff bill has become a law, and people whose business was in a broken down shape now report that they are confident that they can pull through and soon do business on a paying basis. There is every reason to believe that the electrical trade has now been given an impetus which will end in general prosperity."

A. Mitchell Hall, general manager of The C. & C. Electric Company, New York: "There is every possible indication of a marked revival in business, especially in that portion of the electrical field to which we have devoted our partcular attention, that is, electrical lighting and the electrical transmission of power. Not only are orders being placed, but our mail is full of inquiries, which is also a pretty sure indication of business to follow. Altogether, we think the prospects for business this fall decidedly bright."

George E. Long, Secretary of the Joseph Dixon Crucible Company, Jersey City, N. J.: "We, like all manufacturers, have experienced our share of the general depression in business, but we are now experiencing, as we know many other manufacturers are, the upward rise, and are having quite a decided improvement in all our various departments."

H. Ward Leonard, president of the Carpenter Enamel Rheostat Company, Hoboken, N. J.: "Our business has been so recently established that we can hardly make comparisons between our present business and that of past years, but in our particular line the present conditions and prospects for the future are very satisfactory, as we have been obliged to work over time for several months past and are likely to be obliged to do so for some time to come."

R. B. Cissel, secretary of the Backus Water Motor Company, Newark, N. J.: "Our experience for the past season in the goods which we manufacture in the electrical line has shown a great improvement over the business of former years, and a large increase of sales. We believe that the prospects for the improvement of business at the present time are good."

H. J. Gorke, manager of The Electrical Engineering & Supply Company, Syracuse, N. Y.: "We have found business very lively all the way along in some of our lines, and have been unable to find a week when we could conveniently shut down our entire factory for a general vacation. The only thing we have to deplore at present is the competition that has been working disaster in prices on general lines of incandescent appliances. The outlook for a prosperous fall trade is encouraging to us."

S. F. Bagg, secretary Watertown Steam Engine Company, Watertown N. Y.: "We should say that the electrical industry being less affected by tariff conditions, except, of course, as it is in sympathy with other industries, had suffered less from the present depression than almost any other line of business and therefore is less likely to show any very sudden and pronounced reaction. At the same time, so far as our observation goes, business in this line seems to show a marked improvement already. The easy money market and the expectation of an early resumption of business have combined to put fresh life into the many projects that have been held in abeyance for the last year. Besides this we notice a larger number of new enterprises starting than for many months previous. Our mails show a somewhat large number of promising inquiries, but it is still more noticeable that a much larger percentage of inquiries materialize into orders. During the whole of last year we were called on to make estimates and prices almost as often as in the most promising times but the matter generally ended there. In the last month or two we have found that a much larger proportion of these inquiries developed into orders, either to us or to some one else. While the indications for the future do not seem to promise anything in the way of a boom, nevertheless, it seems to us that we have good reason to expect an increasing and permanent and healthy business during the fall and winter."

The Delaware Hard Fibre Company, Wilmington, Del.: "That part of our business which is in the electrical line shows very decided indications of an improvement. For the past three months our sales have been about forty per cent. more than during the same period a year ago and the indications are that this proportion will hold through the fall and probably increase."

Pepper & Register, electrical and mechanical engineers, Philadelphia: "Within the last few weeks we have had a great many new inquiries and we see clearly ahead a great deal of good business, enough we hope, to give all contractors a fair share and to raise prices to a profitable standard."

Carlton M. Williams, secretary and treasurer of Morse, Williams & Company, Philadelphia: "The wisdom of the Philadelphia lawyer is proverbial, but we must confess that it is beyond the power of an ordinary manufacturer to make any accurate prediction as to what the prospect is for an improvement in business during the ensuing fall and winter. We find that some people are ready to take advantage of the extremely low prices prevailing at present to make improvements so that they will be ready to handle business when trade does revive; this no doubt is a wise course to pursue, as there is not near enough trade to satisfy all, the competition being so great that prices are extremely unsatisfactory. Stocks of goods in all lines are so low that when trade does revive, purchasers will no doubt require early delivery."

Charles M. Wilkins, of the Partrick & Carter Company, Philadelphia: "That there is room for improvement is the opinion of business men everywhere. The present state of affairs has not been brought about suddenly, and while the recent action of Congress will undoubtedly have the effect of restoring confidence in business circles, it will be some time before financial, manufacturing and commercial interests can adapt themselves to the changed conditions brought about by the adoption of new tariff regulations. There is another important issue which neither of the dominant parties seem disposed to handle properly, namely: 'The solid money question.' The financial policy of this country must be placed on such a basis as will leave no room for doubt as to its soundness. This is as important as the tariff. I am of the opinion that there will not be any great change for the better during the present year, but I confidently believe that 1895 will be a good year for the business world. Dealers have allowed their stocks to run down to the very lowest notch, and have only made necessary purchases, and when the revival comes supplies of all kinds must be bought, new enterprises will be started, and, to use a slang expression, 'those who stay in the game will come out ahead.'"

J. H. McEwen, president of the J. H. McEwen Manufacturing Company, Ridgeway, Penn.: "Our business has been very good this summer. We are working full capacity with plenty of orders ahead, but as to the future, we believe that the improvement in business will be very gradual."

Maurice W. Thomas, secretary and treasurer of The Mason Telephone Company, Richmond, Va.: "The outlook for business in this section is good. There has been no very great change in the situation since the passage of the tariff bill, but I note a general brightening all along the line. In our own particular branch, that of the construction of telephone plants throughout the country, I am glad to be able to report brisk business, which I feel is but the forerunner of a large trade in the fall."

Chas. F. Thompson, secretary and treasurer of the Lane & Bodley Company, Cincinnati, O.: "The earlier months of the year 1894 found the electrical demand the only one for steam engines. During midsummer sugar and cotton oil interests called upon manufacturers and there is at present a hopeful prospect for the wheat milling interest this fall as an absorbent of the engine supply. Owners of electric lighting plants will lose a golden opportunity if their contracts are not placed this year for new power of the most economical operation, and since it is unreasonable to suppose the active-minded managers of this industry are not alert to their opportunity, we believe the demand for engines for electric industry will steadily increase from this time."

S. M. Hamill, general manager of the Brush Electric Company, Cleveland, Ohio: "The manufacturing and selling of electric lighting apparatus during the past has not been conducted on as conservative a basis as it might have been. The financial and other troubles of the last year have led to a change for the better in this particular. The improvement in business, which will undoubtedly come, will in our opinion not be as rapid as some imagine, but it will be permanent and a greater business will be done than ever before. The manufacturers and local companies have been taught a severe lesson, but will profit greatly thereby."

R. N. King, president of the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio: "Our business with electrical companies is largely with the better class, where first-class machinery is wanted and where in most cases the development depends upon a sale of securities, and the only thing particularly needed now is a good bond market. Our idea is that good water power electrical development bonds, when better known in the market, will be a favorite form of investment, for the reason that the revenue from the sale of electrical power is likely to be a steady and permanent income and not affected by the changes and fluctuation of the markets. The outlook is particularly good for business in our line."

C. K. King, manager of the electrical department of the Ohio Brass Company, Mansfield, Ohio: "In regard to the probable

improvement in the fall and winter trade in electrical supplies, if the new tariff bill will affect the money market so as to enable the promoters of street railway enterprises to sell their bonds there undoubtedly will be many new roads built."

GEORGE CUTTER, Chicago: "I interpret the indications to be very favorable for a steady and a marked improvement in electrical business within the next few months. The increase in demand for money in this city since the passage of the tariff bill indicates a revival of confidence, and if nothing happens to check this the result will probably be a very great help to electrical enterprises. I find that during the business depression many promising and valuable schemes have been worked up, which are only waiting for the money to carry them through. The favorable impression among business men will surely develop that confidence which is needed to induce capitalists to invest, and this is really all we need to make our business thrifty."

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago: "The prospects of a busy fall seem very bright here in all lines, and especially in telephone matters; in fact, at present we have nothing to complain of. This company has contracts for a great many exchanges, and has several under way."

CHAS. E. GREGORY, president of the Chas. E. Gregory Company, Chicago: "We beg to advance the opinion that the general business of the country will experience marked improvement in the fall, particularly the electrical industries. Our inquiries from all over the country lead us to this conclusion, and we have prepared for twenty-five per cent. more business than we did in the fall of 1893. We do not know what hard times are, except by hearsay."

THOS. I. STACEY, secretary and treasurer of the Electric Appliance Company, Chicago: "The electrical supply business, in particular, has felt a marked and steady recovery, dating from about January first. This has been interrupted somewhat by July and August business which is usually very light, and this summer is no exception. This gradual recovery of business will undoubtedly be resumed in September, continuing throngh the coming winter and spring. I do not, however, anticipate a sudden recovery or a very large volume of business during the coming season, but believe that the fall and winter of 1895 will find the business in a fairly normal condition, provided no further setbacks are encountered."

B. E. SUNNY, manager of the General Electric Company, Chicago: "There is a decided improvement, the evidences of which have been many in the last two weeks. It is curious to note that we have had the same number of orders during August that we had a year ago, and the year before that; but the orders recently have been for practically double the quantity required for many months past, showing that station managers have been economizing. I expect that the autumn will be a season of unusual activity in all branches of electrical work and that there will be a gradual and steady improvement from this time forward."

J. B. WALLACE, manager of the Wallace Electric Company, Chicago: "We regard the prospects for an improvement in business as decidedly good; in fact, this improvement has already commenced. There is a notable increase in the volume of business and the amount of inquiry is still more marked, showing that people are considering seriously the question of repairs, reconstauction or increase of their facilities. For more than a year the most rigid economy has been the general rule in Western electric lighting plants, and in many cases they have given orders not to buy anything that could possibly be avoided or done without. In consequence of this the average plant is not in a physical condition to go through another lighting season without making very considerable purchases for repairs and reconstruction, and in addition I look for considerable business in the way of increased facilities, many of which were planned a year ago, but put off on account of the uncertainty."

J. E. KEELYN, president of the Western Telephone Construction Company, Chicago: "The promised improvement in the business situation is shown in the last week's correspondence. Our orders in the last week have run into telegrams of an imperative nature, where in the past letters have been considered quick enough. We all feel that there will be a decided improvement from now on. Money is at a low rate of interest. Real estate enterprises are exceedingly dull and unprofitable, and other lines of effort, particularly manufacturing, will have no trouble in obtaining money on favorable terms, in fact on better terms than in the past. One great trouble with the electrical, as well as other securities, is that they have been too much 'watered,' and capital has lost confidence to a certain extent; but this, I am certain, will be regained now that the hard times have taught many lessons. In the telephone line an extraordinary prospect for sound and profitable investment presents itself, and wherever an enterprise of this character is conducted on legitimate basis, there is no reason why it should not prove a handsome investment. On the whole, therefore, I can safely predict that the country will now enjoy a season of substantial prosperity, better than for a few years past."

F. E DRAKE, of Standard Electric Company, Chicago: "From our standpoint the outlook is more favorable than it has been for many months. All of our departments are running full time and full handed. At the same time the best I look for during the coming winter is business enough, at a fair margin of profit, to give us a living. It will be spring before there is any grand revival. But the change up to the present time is very encouraging."

W. C. MCKINLOCK, secretary of the Metropolitan Electric Company, Chicago: "Business has already taken a decided start and we look for a splendid business this fall. Apparently lighting stations and railways have been waiting for a long time before ordering and now they have taken matters in hand with vigor."

W. W. LOW, president of the Electric Appliance Company, Chicago: "The situation is splendid and the outlook is equally good. It may seem talking 'shop,' but our own business may be taken as an evidence of the general condition. We expect that the improvement will be gradual and steady, and that by spring we may experience something of a boom."

A. WEINBERG, Union Brass Manufacturing Company, Chicago: "Business is gradually and steadily picking up. The evidence of prosperity already at hand leaves no doubt in my mind that the fall will be one of very noticeable activity and the winter should bring us a good business at reasonable profits."

J. H. RHOTEHAMEL, president of the Columbia Incandescent Lamp Company, St. Louis, Mo.: "We have noted a decided improvement in our business during the past few weeks. The improvement does not seem to be confined to any particular part of the country, but is general, coming from all sections. We look forward to a larger business this fall and winter than at any time heretofore since the organization of our companya, nd think that the improvement already noticed confirms our views. We believe that recent improvements in high economy incandescent lamps will very materially increase the electric lighting business, as it will bring the price of electric lighting nearer to that of gas and the use of incandescent lamps will be largely stimulated thereby."

The New Tariff Schedules and Electrical Manufactures.

Owing to the general criticism of newspapers in regard to the loose manner in which the new tariff bill has been drawn up, those whom its provisions may affect are chary of expressing an opinion, particularly in regard to items whose classification may be subject to new rulings. It does not appear, however, that the electrical industries will be notably affected, though in one or two instances, hereafter referred to, it is possible that foreign competition may result.

While unmanufactured copper is placed on the free list, this will introduce no change, as the principal foreign supply is imported from the United States. Bare and insulated copper wires will also be unaffected, though the duty on the former is reduced from 45 per cent. to 35 per cent., and on the latter from 35 per cent. to 30 per cent., vulcanized rubber and indurated fiber also coming under the latter figures. A large cut is made in bar zinc—to 1 cent from 1¾ cents per pound; unpolished sheet zinc is reduced from 1¼ cents to 1 cent per pound, and scrap zinc from 45 per cent. to 35 per cent.

The duty on electrical machinery is reduced from 45 per cent. to 35 per cent. Arc lamps come under this classification, but the duty on arc light carbons remains unchanged at 20 per cent. The former duty of 60 per cent. on electric shades becomes 40 per cent., and that on porcelain is reduced from 55 per cent. to 30 per cent. Notwithstanding these large reductions, we are informed that they will have little effect in increasing importations, though on some goods somewhat lower prices may result, both on imported wares and on domestic wares at present competing with imported articles.

Notable reductions are made in duties on iron, of which the most important affecting the electrical interests are those relating to thin sheets of iron or steel, such as are used for armature discs, as under the former rates this material was sometimes imported. The duty on sheets between Nos. 10 and 20 gauge is reduced from 1 cent per pound to .7 cent; between Nos. 20 and 25, from 1.1 cents to .8

cent; and above No. 25, from 1.4 to 1.1 cents. Forgings of iron and steel are reduced from 2.3 to 1.5 cents per pound (provided this be not below 35 per cent. ad valorem), and iron castings from 1.2 cents to .8 cents per pound. Steel castings valued between 4 and 7 cents per pound, are reduced from 2 to 1.3 cents per pound; valued between 3 and 4 cents, from 1.6 to 1.2 cents; between 2.2 and 3 cents, from 1.2 to .9 cent. between 1.8 and 2.2 cents, from .9 to .7 cent.

Heretofore incandescent lamps have come under the classification of "Manufactures of glass not otherwise provided for," on which the duty has been reduced to 35 per cent. from 60 per cent. Should this classification be adhered to, foreign lamps may be able to compete with those of domestic manufacture at present prices, as they can now be delivered in New York at 25 cents per lamp, duty and freight paid.

Tesla Effects with Simple Apparatus.

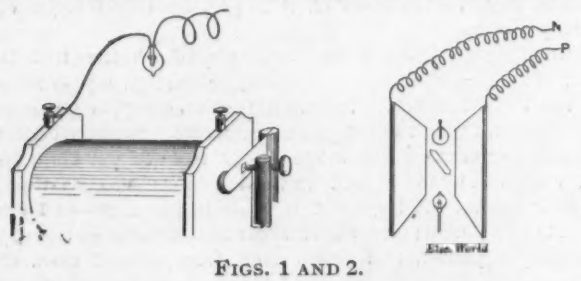
BY H. M. MARTIN AND W. H. PALMER, JR.

All who visited the room in the Electricity Building at the World's Fair in which Mr. Tesla's high frequency apparatus was exhibited must have brought away with them a lively desire to repeat at their leisure the beautiful and interesting experiments there shown; but a recollection of the many expensive appliances used in obtaining the effects has doubtless deterred many from entering upon what must prove a valuable and absorbing line of study. It is the object of this paper to show that no one need fear failure in this field who has at his command the simple apparatus to be found in the most unpretentious laboratory; nor should it be thought that results are less instructive or of smaller scientific value when obtained in this way than when obtained by the use of more powerful apparatus.

Some years ago the writers, while testing a small Ruhmkorff coil, connected up a burnt-out miniature incandescent lamp between the secondary terminals. On closing the primary circuit the usual violent discharge was set up between the broken ends of the carbon. While the current was on one of the connections became unfastened, leaving the lamp joined to only one of the coil terminals, as in Fig. 1; and the discharge instead of being extinguished, changed to a soft glow that filled the whole interior of the lamp. This was, on a small scale, identical with the experiment performed so brilliantly by Mr. Tesla during his London lecture, when he lighted an exhausted bulb, having a sealed-in electrode, through a single lead from a source of high potential and frequency.

Although this experiment was often repeated, its significance was not realized until Mr. Tesla made known the results of the researches which have entitled him to rank among the foremost investigators of our times. But the published report of the lecture placed the previous experiment in its true light, and inspired a hope that other effects might be duplicated with the feeble apparatus at hand. The results have more than fulfilled our expectations.

The necessary potential and frequency were obtained from a small



FIGS. 1 AND 2.

Ruhmkorff coil capable of giving a quarter-inch spark when operated by three Bunsen cells.

Two insulated metallic plates 12"x12" in size were placed about three inches apart and connected with the terminals N and P (see Fig. 2). Exhausted bulbs, miniature incandescent lamps, Geissler tubes, etc., were then introduced between the plates, and glowed brightly without any direct connection with the plates or coil. Actual photometric measurements of the maximum light emitted by this arrangement show it to be greater than that obtainable by using the current directly in an incandescent lamp. This is significant as showing the poor economy of the present methods of electric lighting, and leads us to believe that molecular bombardment electrostatically sustained contains great possibilities in this connection.

A slight modification of this arrangement makes it possible to dispense with one of the two plates. In all these experiments the battery cells act as a species of reservoir or condenser, so that tubes and bulbs lying in their vicinity are often seen to glow brightly and fade, in proportion as the capacity of the apparatus is changed.

Incandescent lamps may be lighted through a single lead from one of the secondary terminals; this effect is greatly heightened if the hand or some other object of capacity is placed near the lamp bulb. The small 6 c. p. lamps are peculiarly adapted for use in these experiments, their shape seeming to concentrate the molecular bombardment upon the carbon filament.

If a good mercurial air-pump is not accessible, vacuum tubes that will serve for want of better may be obtained by heating mercury in a piece of tubing, and sealing the end after the mercury has reached the boiling point. A pretty experiment may be performed by holding the exhausted tube in one hand, with one end near the coil terminal, and then passing the other hand down the length of the tube, extinguishing the glow and giving the effect, as a friend expressed it, of "wiping the moonshine off."

Many other combinations will suggest themselves to the investigator, but there is one experiment which, since it depends upon a principle that has not, to the writer's knowledge, received as yet any published explanation, should be of special interest.

This phenomenon, a description of which has already appeared in

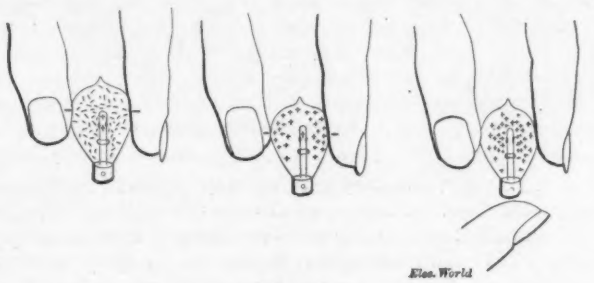


FIG. 3.

these columns,* may be satisfactorily observed with the small induction coil by proceeding as follows:

Holding the bulb of a miniature incandescent lamp in the hand, bring the leading-in wire into contact with the coil terminal; the bulb will be filled with the usual phosphorescent glow. If, now, the lamp is slowly withdrawn from contact with the terminal, this light will gradually fade, as the confines of the field are approached, and concentrate itself around the interior carbon. Soon a point will be reached beyond which the glow does not diminish through further removal from the coil. It is now quite self-sustained, and cutting the current off from the coil will not effect it in any perceptible way. This phenomenon we have called the "afterglow."

When obtained in this way, the afterglow will continue for from one to two minutes after the coil is shut off. The lamp may be carried glowing from room to room; if put down out of the hand the light becomes fainter, but is not extinguished. After some minutes, when the glow has faded quite away, a sudden flash may be observed if the leading-in wire is touched with the finger. Several of these flashes may sometimes be obtained before the bulb is entirely discharged.

It must not be supposed that this glow is due to heat remaining in the lamp carbon, the heating effect of so weak a coil being quite insignificant. A consideration of the accompanying figures will show the purely electrostatic nature of this phenomenon.

When the lamp is withdrawn from the alternating field, the interior electrode retains a charge differing in sign or intensity from that of the rarefied gas in the bulb and that induced in the fingers of the experimenter, Fig. 3. The natural consequences of this state of unequal charge are molecular bombardments and collisions more violent in the immediate neighborhood of the electrode, because of the small surface over which its charge is distributed. When electrical equilibrium has been established between the gas molecules and the electrode, this interchange of charge ceases, and the glow dies away. The condition of affairs at this moment is shown in Fig. 4.

Discharging the electrode will now cause a sudden rush of molecules toward it to re-establish equilibrium (see Fig. 5), giving rise to the momentary flash observed, and this may be repeated until no charge remains in the lamp.

This is, perhaps, the simplest arrangement ever devised for obtaining light from electricity, and it may not be extravagant to say that it embodies the fundamental principles of an economical system of artificial illumination.

*"The Afterglow in Exhausted Bulbs," The Electrical World, Jan. 20, 1894.

ELECTRICITY IN CHURCH

Electricity has not occupied so prominent a place in the church as the ease with which it lends itself to decorative and illuminating purposes would seem to warrant. Perhaps it is because the church is more conservative than the world and less inclined to don the garb of modern civilization; or possibly it is because of that ancient superstition of man that a "dim religious light" is more conducive to a spiritual mood than any artificial glare. Into many churches, however, and especially those of very recent construction, the electric light has made its way and has proved so thoroughly satisfactory as to become indispensable. It is often the case, unfortunately, that the lights are so few, and installed with so little regard to brilliancy of effect or harmony with architectural details, that the result is far from pleasing.

The First Baptist Church, which stands on the northwest corner of the Boulevard and West Seventy-ninth street, New York City, has been unusually progressive, and has sanctioned the use of electricity not only as a means of illumination, but for other purposes as well, ministering to the convenience and comfort of the pastor and the congregation.

The church occupies a prominent site on the boulevard and its grace and harmony of design reflect much credit upon the architect, Mr. Geo. Keister. The building is Byzantine in style, the material of the outside being buff Indiana limestone with the face point-tooled. The base is of Milford granite. The Spanish tile roof is of yellowish brown color, in keeping with the general tone of the exterior.

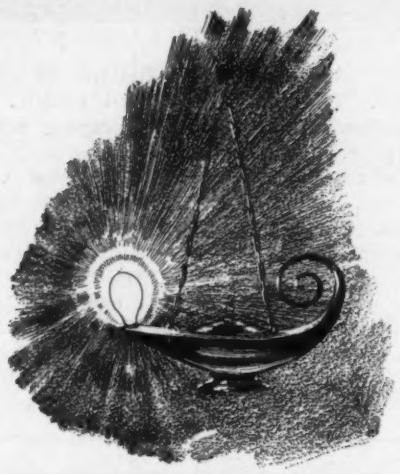
The interior of the church is very attractive and embodies some quite novel ideas. The special feature of the building may be considered its shape and the lighting of the auditorium. The auditorium is elliptical in form with its major axis on the diagonal of the lot, which is approximately 100x105 feet in area. The inside measurements of the ellipse of the auditorium are 59x101 feet, and the highest point in the ceiling is 72 feet from the floor.

It is perhaps the ceiling itself which presents the most striking peculiarities of construction. It is made up of a grand vault thirty feet in diameter, with two half vaults—one on either side—of almost the same diameter, forming large coves. The upper portions of the vaults—about two-thirds of the whole—are of leaded glass covered on the outside with ordinary three-eighths inch rubber skylight glass, glazed on the rake of the roof, which is nearly 45 degrees. The daylight is taken through this leaded glass and gives a strong and powerful illumination with practically no shadows.

At night the auditorium is lighted by 240 incandescent lamps concealed behind the leaded glass between it and the plain glass

THE CHURCH BY NIGHT.

roof. The light is reflected through the leaded glass, the individual lamps not being visible, as they are in all cases from seven to nine feet from the glass. In addition to these lights there are 60 lamps concealed in the apse of the church and not visible in the auditorium except by reflection, while about 70 more are distributed over the choir gallery, being shaded to light the music, and placed behind an arch at the back of the auditorium for the purpose of lighting up a large rose for effect on the outside front. The remainder of the lights installed are distributed about the building on the ordinary combination fixtures.



The Old and the New.

It will be seen that the scheme for lighting is a novel and interesting one. The interior effect is most pleasing, as will appear from the illustration on the opposite page. The light is soft and distributed with unusual evenness, so that one can read with ease in any part of the church. But perhaps the most striking part of the plan is the effect from the outside. The light streaming through the glass roof makes it one broad sheet of light, at first giving the impression that the building is on fire. A group of lights on the top of the steeple heightens the effect, and with the light which

A Suggestion.

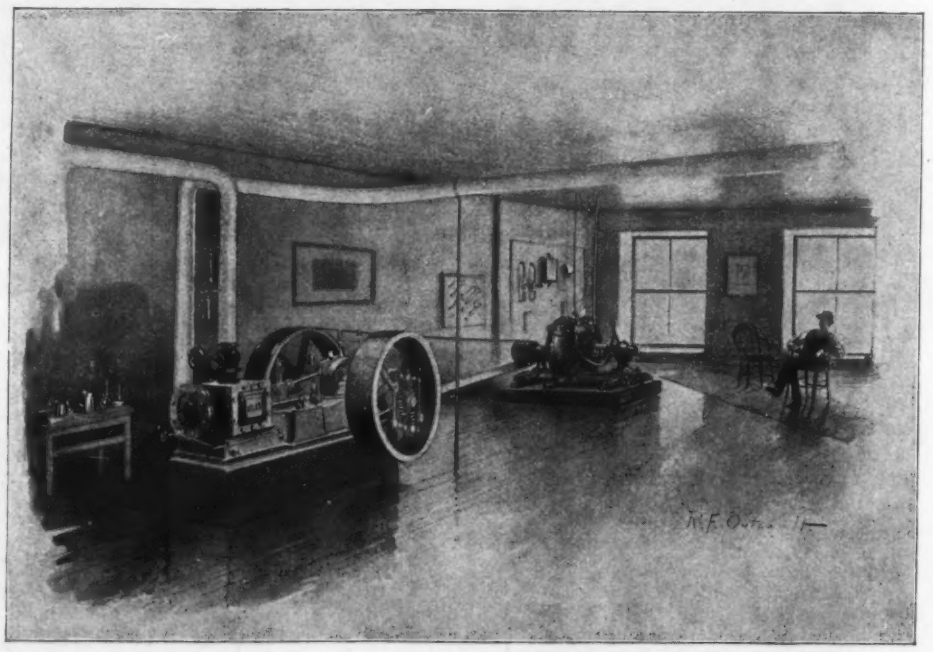
pours through the roof and windows, instantly challenges the attention of the Boulevard pedestrian, who might easily persuade himself that he was in Madison Square and gaze aloft in search of the gilded form of the fair "Diana." It was not the original intention to have the roof of clear glass, as much of the light is thus lost, but it was finally concluded that a part of the brilliancy on the interior could be sacrificed in order to attract the attention of the outside world. One of the difficulties incidental to this method of lighting is that unless the leaded glass, behind which the lights are placed, is kept reasonably clean, the light is considerably reduced. Provision was made for walking over and sweeping off the glass, but the sexton, doubtless thinking discretion the better part of valor, has manifested an unfortunate disinclination to trust himself upon anything but the main floor.

Electricity is not used for lighting alone in this progressive church. The patient organ blower has been replaced by an equally patient and much more reliable form of motive power—a small electric motor. The organist has also arranged an ingenious electrical device, through which, by manipulating keys on one of the key boards, he can play a chime of bells. The pastor himself has established electrical signals between the ante-room and the pulpit and the organist, so that he can inform the latter when he is ready to come on to the platform or has nearly finished his sermon.

A very pretty little effect is produced by the employment of the electric light in an altar lamp, shown in one of the accompanying illustrations. This lamp is almost a history of lighting in itself, uniting as it does the most ancient and the most modern forms of illumination.

The dynamo plant is shown in one of the accompanying illustrations. The generator is a 25 kw. bi-polar, compound wound "C. & C." machine, running at 900 revolutions, driven by a high-speed "Atlas" engine. The switchboard is equipped with the usual measuring and indicating instruments and switches. Messrs. H. Ward Leonard & Co. were the electrical contractors.

Altogether, the First Baptist Church of New York may be considered to be one of the most perfectly appointed, from an electrical standpoint, of any in the country. It is believed to have been the first in which an isolated plant was installed.



The Dynamo Room.

Injurious Static Discharges.

A correspondent informs us of a curious experience he recently had with a 35-kw 500 volt motor. One morning the attendant noticed a bad flash between the poles, which apparently came from the armature. On testing, a short circuit was found, and upon taking the motor apart it was discovered that the insulation was burned off a small spot on two adjacent coils and the wires partially fused together. The next morning at about the same time the same thing occurred again, and it was concluded after closely watching the phenomenon that the cause was a static discharge due to the effect of two large belts running quite near, though well grounded collectors were in position over and under the belts. After grounding the bed of the motor, however, there was no more trouble. Our correspondent cannot explain why the coils should fuse together in the same manner every time, though this might have been due to the carbonized insulation acting as a conductor. The motor had been running over two years previously under the same conditions without any trouble being developed.

INTERIOR VIEW OF THE CHURCH.

18 ANNUAL MEETING 94 OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AUG.

The meetings of the Association were brought to a close on Wednesday last. With the exception of the papers before the Physical Section (B) on Monday, comparatively few papers were presented which were of real interest to the electrical profession. In Section A Ormond Stone read a paper on "A Simple Proof of Radau's Symmetrical Form of the Differential Equations of Relative Motions of the Planets;" Aaron N. Skinner a paper on "Sketch of Zone Observations at the Naval Observatory;" and Edgar Frisbee, the new vice-president of the section, a paper on "Gilliss' Catalogue of Southern Stars."

Before the section of Mechanical Science and Engineering, Prof. Plympton delivered an address on "Some Reminiscences of the Early History of Iron Bridge Building in the United States," in which he recalled some interesting incidents in iron bridge construction, from its inception in 1856.

In the Physical Section (B), however, some interesting and valuable papers were read on Monday, the last day of the meeting of this section. Prof. Samuel Sheldon presented a paper on "A Calorific Effect of the Velocity of Migration of Hydrogen Ions." Prof. Sheldon exhibited the phenomenon of the "pail forge" as it was shown at the World's Fair last year. A large electrode of lead was placed in a jar which is filled with any kind of conducting fluid and has a layer of sand at the bottom. A bar of iron of small cross section is made the cathode for the current. When the small electrode is placed in the liquid there is a great production of light and heat in the part immersed. Prof. Sheldon has found from his own experiments and those of others that one electrode must be large compared with the other, the heating taking place at the small electrode; that any electrolyte or conducting liquid may be used. There is an unstable period while gas bubbles come off; with sufficient electromotive force the luminous envelope is produced, the color of which depends on the electromotive force, the electrolyte and the electrode. The current is steady and relatively small. The electromotive force varies as the specific resistance of the solution; it is independent of the nature of the electrode, but depends on its form and size. The theory of the phenomenon advanced is as follows: The inability of hydrogen ions to travel beyond a certain velocity results in a heating of the cathode, if sufficient electromotive force is applied, so that Faraday's law requires the hydrogen to migrate faster than its maximum velocity.

A paper on "The Radiation of Obscure Heat by a Metal Mass," was read by Prof. B. W. Snow. A mass of cast-iron weighing one hundred pounds heated to 100 C° or cooled to 0° C′ was placed near one of the bars of the inferential comparator, and the expansion or contraction of the bar was noted. It was found that at first but little effect was produced. Soon, however, the bar expanded or contracted according to the temperature of the mass near it, and reached a maximum nearly two hours after the mass was placed in position. The bar then tended to resume its normal length, and reached that condition not less than twenty-four hours after the effects of the mass had first been detected.

"The Infra-Red Spectra of Metals," was the subject of a paper by E. P. Lewis and E. S. Ferry. This paper is simply a preliminary notice of work now in progress. The method consists in the use of a diffraction grating of 21 feet 6 inches focus, with 1,400 lines per inch, in connection with a bolometer and galvanometer. The galvanometer has a sensitiveness of 10^{-9} and the galvanometer of .00001 dyra centigrade. The bolometer is arranged differentially so as to eliminate the effect of the flickering of the arc. The region thus far investigated extends to wave length 12,000 Agstrom units. Several lines have been located, but the wave length not yet actually determined. Among such lines are two pairs of Sodium lines of wave lengths approximating 8,190 and 8,200, and 11,468 and 11,488. These observations agree very well with values obtained from the empirical formula of Keyser and Runge.

Dr. F. Bedell, in his paper on "Magnetic Potential," pointed out the effect of permeability upon the magnetic potential at a point due to magnet or to a current of electricity.

C. J. Rolleson presented a paper on "A Phonographic Method for Recording the Alternating Current Curve." To produce the alternating current curve by the aid of the phonograph two operations are necessary; first, a record of the curve must be produced on the wave cylinder of the phonograph; second, the record produced in the first operation must be magnified by means of a suitable multiplying arrangement. The method seems especially adapted for the study of harmonics in the alternating current. By the aid of König's apparatus the number of harmonics present may be determined, and perhaps their relative intensities. Their relative positions may then be determined by plotting the curve. These operations may be repeated several times, and thus each operation may serve as a check on the others.

"A New Recording Thermometer for Closed Spaces," was described by W. H. Bristol, of Stevens Institute. A coil in the closed space or oven where the temperature is to be measured is connected to the recording part by means of a small copper tube. The recording part may be 25 feet or more from the point at which the temperature is to be measured. The coil is partly filled with alcohol and the air is exhausted. When the coil is exposed to the high temperature, pressure is produced corresponding to the temperature. The pressure is communicated to the recording gauge through the small connecting tube, which becomes filled with condensed vapor of the alcohol; thus the indications of pressure are not affected by ordinary changes of temperature in the room where the recording part is located. A special feature of this instrument is that the graduations on charts are very open on the upper portion of the scales.

"On Some Magnetic Characteristics of Iridium," was the subject of a paper by Prof. S. H. Brackett, in which he gave an account of examinations and tests of iridium showing characteristics which do not appear to have been noted before. The iridium was prepared by John Holland, and stated by him to be free from iron. In the magnetic field a bar is more readily magnetized transversely than longitudinally, as ordinary stroking methods of magnetizing produce very irregular distribution of magnetism. The magnetic intensity, compared with that of steel, is as 1 to 12. The largest bar used was about 2½ cm. long. Special apparatus was constructed to test the permeability, which was found to be practically zero. Position or movement in a magnetic field is not sufficient to magnetize it; it must be jarred. By magnetizing in that way in contact with the poles of an electro-magnet, and using different strengths of current, the curve of susceptibility was obtained. Examination of the distribution was made by means of a small suspended magnet; also apparatus was constructed for magnetizing by octuple touch, that is, stroking the four sides at once. Low permeability, great coercitive force, and a magnetic intensity not recorded before, are claimed as results of the investigation.

A paper on "Lightning as a Case of the Dissipation of Energy" was read by N. D. C. Hodges. A few years ago, by looking through the records of lightning disasters, Mr. Hodges hit upon the idea of the lightning dispeller. It consists of one or more thin copper ribbons running from the highest point on the building to be protected to the lowest, at intervals of thirty or forty feet. This ribbon runs seventy-five feet to the ground, and is so put on as to insure its destruction by the lightning. The deflagration of such a conductor, Mr. Hodges said, has invariably been found to result in the protection of all else. Mr. Hodges' philosophy is this: Lightning destroys; that is, there is power in it which manifests itself in broken masonry, etc. This energy must be used up on something. He does not know how much energy it takes to deflagrate a pound of copper; he only knows that no lightning discharge has ever manifested enough energy to deflagrate more than two or three pounds. He also gave his theory of the stress in electrified air, and stated that there might be a foot pound of energy in every cubic foot. In discussing the paper, Prof. MacFarlane made a calculation on the blackboard from Mr. Hodges' data. According to Mr. Hodges a cubic mile of air might discharge its energy in one flash; this

would be represented by a number involving twelve figures. A rough calculation of the energy required to deflagrate a pound of copper gave it as a number involving six figures only. The one quantity was one million times the other. He also showed that a man would in 75 minutes do as much work as was involved in deflagrating Hodges' pound of copper, and asked whether a man, working at an average rate for 75 minutes, could split a great tree. such as we see done by a discharge of lightning. Prof. McAdie asked Mr. Hodges whether he had read Lodge's book, and he also quoted Lord Kelvin's saying that a properly constructed system of lightning conductors gave us a very comfortable protection against a thunderbolt.

The last paper was by Alexander McAdie, on "Some Peculiar Lightning Flashes." In June, 1894, one hundred persons were killed by lightning in the United States; in July the number was at least as great. Accurate knowledge about lightning discharges is, therefore, of practical importance. So far, all photographs of flashes exhibit the flash in one flame, not in space. To obtain the correct path in space it is necessary to have two or more photographs taken from very different points of view. Mr. McAdie had three cameras pointed at the summit of the Washington monument in the city of Washington—one at the Capitol, 1.4 miles distant; a second at Fort Meyer, 4 miles distant, and the third at the Weather Bureau, 1.3 miles distant. He showed photographs of some peculiar flashes; a multiple meandering flash, an impulsive rush with dark flashes along its side, a flash ending in a cloud, and a flash with bright side flashes.

On Monday afternoon, through the courtesy of Mrs. J. S. T. Stranahan, the scientists enjoyed an excursion to various points of interest about the bay. On Thursday a large number of members and their friends made a trip up the Hudson to West Point, returning in the afternoon in time to connect with the Providence steamer for the excursion to the White Mountains, under the auspices of the American Forestry Association.

The officers chosen unanimously by the association for next year's meeting for sections A, B, and D are as follows: President, E. W. Morley, Cleveland, Ohio; vice-presidents, mathematics and astronomy, E. S. Holden, Lick Observatory: physics, W. Le C. Stevens, Troy; mechanical science and engineering, William Kent, Passaic, N. J.; secretary of the Council, Charles R. Barnes, Morrison, Wis.; secretaries of the section, mathematics and astronomy, E. H. Moore, Chicago; physics, E. Merritt, Ithaca; mechanical science and engineering, H. S. Jacoby, Ithaca.

It was announced that the new members added to the association at the Brooklyn meeting numbered 213, and that forty-eight had been elected Fellows for "eminent services to science." Dr. William H. Hale was reinstated as one of the original Fellows from 1874.

San Francisco was indicated as the place of next meeting, provided suitable reduction of rail fare can be secured.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

This association was organized at the World's Engineering Congress at Chicago last year, and now comprises among its 150 members many of the well-known engineering educators of the country. The meetings were held on Monday, Tuesday and Wednesday of last week, and a number of interesting papers were presented, many of which, however, were only read by title. Prof. De Volson Wood, of Stevens Institute, as president of the society, delivered a very able address on "Technical Education." Prof. F. O. Marvin, of Kansas State University, took up the question of "Entrance Requirements Common to All Engineering Schools." He believed that some standard should be adopted throughout the country, and outlined what he thought constituted the proper requirements for admission to a high grade engineering school. He recommended that the society should appoint a committee to consider the question and report at the next meeting.

"Engineering Education and the State University" was the subject of an interesting and instructive paper by Prof. W. S. Aldrich, of the University of West Virginia, in which the author ably considered the question of the engineering school in connection with the State University.

"Graduate and Post-Graduate Engineering Degrees" was a subject which aroused considerable interest and was participated in by Profs. Palmer C. Ricketts, of the Rensselaer Polytechnic Institute, George F. Swain, of the Massachusetts Institute of Technology, and Robert H. Thurston, director of Sibley College, Cornell University. Prof. Ricketts said that the engineering course pursued, and not the degree, counts, and that after an engineer has had some experience and has become a member of a recognized engineering society, he very seldom uses his school degree, but adopts the abbreviations of the professional society instead. Dr. Thurston believed that the form of the degree ought to depend upon the nature of the course. In some schools a liberal education is given to students along with engineering science. Others have a more distinctly professional aim, assuming that the student is already trained in the liberal art and wishes to take up engineering as his life work. The general consensus of opinion seemed to be that the old academic degrees were not of much use.

Prof. Mansfield Merriman, of Lehigh University, read a paper on "Teachers and Text-books in Mathematics for Technical Schools." He pointed out that teachers of pure mathematics in engineering courses of study are most successful when in close sympathy with technical practice. Mathematics is to the engineer a tool for the solution of problems in investigation and design, and hence practical problems could be chosen for the illustration of principles and methods.

Prof. J. B. Johnson, of Washington University, St. Louis, Mo., spoke on "The Teaching of the Specifications and the Law of Contracts to Engineering Students." He recommended the preparation of a small text-book containing a synopsis of the law of contracts and a description of the various documents entering into an engineering contract.

Prof. J. J. Flather, of Purdue University, read a paper on "Teaching Mechanical Drawing and Lettering in Engineering Schools," in which he emphasized the importance of both mechanical and free-hand drawing. As drawing is the language of the engineer, it is of the greatest importance that the student be properly taught to express himself, and that his methods conform to those in vogue among practical men. The machine shop drawing is simply a memorandum, showing what is to be produced. It is necessarily an illustrated memorandum, and to be perfect, it should answer all questions which a workman can reasonably ask in regard to the work. It is not necessary to have a finely finished drawing, in fact, shop drawings should not be finely finished. As free-hand sketches enter largely into the work of engineering, the importance of teaching free-hand drawing cannot be over-estimated, and although it may not be generally considered as mechanical drawing, yet its common use in the drawing room and shop entitles it to be properly classed under this general head. Exercises in lettering should begin with the first work in free-hand drawing and should be continued throughout the entire course.

Prof. Storm Bull, of the University of Wisconsin, spoke on "Some German Schools of Engineering." He described the various engineering schools of Germany, notably those at Berlin, Dresden, Munich and Karlsruhe, and the Polytechnikum at Zurich, Switzerland. Of the German schools, that at Berlin has altogether the best equipment and strongest teaching force. The result is that the number of students at that school is nearly two thousand, Munich coming next with 1,800. The Prussian government is doing its utmost to concentrate everything at Berlin, taking the best professors of the other engineering schools in Prussia to Berlin as soon as a vacancy occurs, the result being that these other schools in Hanover, Aix La Chapelle, etc., have not been able to keep up with the better schools. The school at Zurich stands alone and has in some respects the best equipment. The number of students is about 1,300, of which about one-half are foreigners, coming from all parts of the world. The method of instruction in all these schools is by means of lectures. At Zurich these lectures are supplemented by weekly reviews, with compulsory attendance, whereas in all the schools of Germany no restrictions are placed on the students, so that they may work or not as they please. It was stated that the result is that the students at Zurich work very much harder than the students at the German engineering schools. Dr. Bull thinks the lecture system as practiced at Zurich the best method of instruction for juniors and seniors in our engineering schools, especially if the professor furnishes notes of the lectures beforehand. He states that in general the mechanical laboratories are very poorly equipped in all the schools mentioned, and that very little laboratory work is required of the engineering students. The same is true of work in the machine shops.

Perhaps the most interesting paper, from an electrical standpoint, was that of Prof. D. C. Jackson, of the University of Michigan, on "Electrical Engineering Laboratories," an abstract of which will be found in another column.

The following officers were elected for the ensuing year: President, Prof. George F. Swain, of the Massachusetts Institute of Technology; Vice-Presidents, Dr. R. H. Thurston, Director of Sibley College, Cornell University, and Professor F. O. Marvin, of the University of Kansas; Secretary, Prof. J. B. Johnson, Washington University; Treasurer, Prof. Storm Bull, University of Wisconsin.

BRITISH ASSOCIATION MEETING AT OXFORD.

Abstracts of the Marquis of Salisbury's presidential address and the addresses of the presidents of Sections A (Mathematical and Physical Science) and G (Mechanical Science), as well as a number of the papers read before the Oxford meeting of the British Association, have already been presented to the readers of the Electrical World. The following synopsis of the daily proceedings of the society may be found of interest:

Lord Salisbury delivered his address on Wednesday, August 8, while the addresses of the presidents of Sections A and G were made on Thursday, August 9. In Section A, after the delivery of the presidential address, a paper on "Preliminary Experiments to Find if Subtraction of Water from Air Electrifies It," by Lord Kelvin and Messrs. MacLean and Galt was read, an abstract of which was printed in The Electrical World of last week. Prof. Quincke, of Heidelberg, and Profs. Lodge, J. J. Thomson and Fitzgerald questioned the validity of the method of experiment, pointing out the various ways in which the results might be accounted for. Prof. Schuster defended it, and Lord Kelvin, in reply, stated that Prof. Schuster was quite right. The next paper was on "Preliminary Experiments for Comparing the Discharge of a Leyden Jar Through Different Branches of a Divided Channel," an abstract of which appeared in our last issue, describing some researches recently carried out by Lord Kelvin and Mr. Galt. In the discussions, Dr. Lodge gave an interesting account of his theory of the alternative path in condenser discharges, and explained why it is that an iron path has a greater damping effect than a copper one. The morning session was concluded by a paper by Dr. Lodge on "Photo-Electric Leakage," in which he described the experiments of Hertz, Lodge, Elster and Geitel on the effects of ultra-violet and polarized light in the diselectrification of positively and negatively electrified surfaces.

On Friday, August 10, the chief electrical papers were presented in Section B, which is usually occupied with chemical subjects. A discussion on "The Behavior of Gases with Regard to Their Electrification and the Influence of Moisture on their Combination," had been arranged for, and the first paper on the subject was contributed by Prof. J. J. Thomson, and dealt with the resistance of electrical stress for gases in various degrees of moisture, Prof. Thomson's remarks being illustrated by a number of experiments. The two succeeding papers showed that, in certain cases at any rate, there is a parallel between the electrical and the chemical importance of aqueous moisture in gases. The reading of these papers was followed by an informal but interesting discussion, participated in by Prof. Schuster, Mr. Baker and Prof. J. J. Thomson. In the meantime, before the combined sections of A and G, a discussion had been going on on the subject of "Integrators, Harmonic Analyses and Integraphs, and their Application to Physical and Engineering Problems." The discussion was opened by Prof. Henrici, who exhibited some of his own instruments. A debate on "Flight" before the combined Sections had drawn in also a large portion of the audience of Section B. The discussion of this subject was opened by an address by Lord Kelvin on the resistance of solids moving through fluids. Mr. Maxim then described his flying machine, after which Lord Rayleigh asked and replied to the question: What is a flying machine?

On Saturday, August 11, on account of the large number of contributions to Section A, a division was made; one sub-section taking up a list of some fifteen mathematical papers, while another considered the reports of various committees and some physical papers, and a third dealt with papers of a physical-chemical nature. The mathematical sub-section adjourned until Tuesday. In the second sub-section Prof. Osborne Reynolds showed an interesting series of experiments on the boiling of water in an open vessel with a constricted tubular orifice. In the physical-chemical sub-section, two electrical papers were discussed, one by Mr. H. Stansfield on "The Relation Between the Surrounding Gases and the Electrical Conductivity of Thin Soap Films," and the other by Mr. W. C. Dampier-Wetham on "The Velocity of the Hydrogen Iron Through Solutions of Acetates." Meanwhile Section G had busied itself with three important papers, including one by Mr. B. Donkin on "The Most Economical Temperature for Steam Engine Cylinders."

On Monday, August 13, in section G (Mathematical Science) the first paper was by Mr. W. H. Preece on "Signalling Through Space," to which we refer editorially, in which he reviewed his researches in this method of signalling, and concluded with particulars of his most recent work on the subject. Prof. S. P. Thompson then presented his paper, abstracted elsewhere in this issue, on "Some Advantages of Alternating Currents," which was followed by one by Mr. T. Parker on the "Continuous Current Distribution of Electricity at High Voltage, Being a Description of the Lighting of the City of Oxford;" the result was a spicy discussion by the authors of the two papers. In the Physical Section (A) Dr. A. Schmidt read a paper on "A New Analytical Representation of Terrestrial Magnetism," which proved to be an extension of Gauss's expression enabling the internal and external components of the terrestrial force to be expanded in separate terms. (This paper apparently deals with the same subject as that of L. A. Bauer, read before the American Association for the Advancement of Science, and abstracted in our last issue.) A paper by Prof. Schuster was then read on "Suggested Explanation of Secular Variations of Terrestrial Magnetism," an abstract of which will be found in the Electrical World of August 25. In a paper on the Minimum Current Audible in the Telephone," Lord Rayleigh showed that the degree of sensitiveness depends on the nearness of the frequency of the impulses to the natural periods of vibration of the disc, the greatest sensitiveness being obtained when the frequency of impulse was identical with the natural frequency of vibration. Several other papers were also read, the subjects being chiefly of minor electrical interest.

On Tuesday, August 14, a joint discussion took place before the physical and physiological sections on theories of vision, which was inaugurated by some brilliant experiments and two important papers by Prof. O. J. Lodge. The first paper was on "Experiments Illustrating Clerk Maxwell's Theory of Light," in which the phenomena of electromagnetic radiation were very beautifully and convincingly demonstrated. This paper was introductory to the one on "An Electrical Theory of Vision," which immediately followed, and its direct purpose was to initiate the physiologists into the researches of Hertz, Lodge and others on the subject of electromagnetic waves. Prof. Lodge, in his second paper, disclaimed the intent of advancing a "theory" of vision, and urged that his communication was rather in the nature of a question put to physiologists as to whether it is possible that anything resembling the action of electromagnetic waves on a coherer could be supposed to take place in the vertebrate eye. The gist of Prof. Lodge's hypothesis is, that a simple electric circuit, consisting of a coherer contact and an otherwise closed circuit, with or without a seat of electromotive force, may be taken as an analogue and considered to be an enlarged model of the mechanism of vision. Lord Rayleigh, in the discussion which followed, after congratulating Prof. Lodge on the ingenuity of his hypothesis, stated to the Physiological Section, that physicists could object neither to the Young-Helmholtz theory nor to that of Henry, provided that three independent variables in the system of equations were granted. There might be six variables in all, three dependent and three independent. The discussion was also participated in by Profs. Burdon-Sanderson, Schafer, Armstrong and others. A division of the Section then occurred, one portion being occupied with papers on optics, while the other considered papers relating to electrical standards. The formal report of the Committee on Electrical Standards was read by Mr. R. T. Glazebrook. Prof. Viriamu Jones communicated the results of a "Determination of the International Ohm in Absolute Measure." Lord Rayleigh said that no method previously used for finding the ohm could compete in point of accuracy with that used by Prof. Jones. In the meantime Section G had been listening to a number of important papers, among which was the valuable report of the Committee on Dryness of Steam, submitted by Prof. Unwin, and a paper on the "Hunting of Governed Engines," by Mr. J. Swinburne.

On Wednesday, August 15, the sessions were very short and a number of the papers were withdrawn. In the Physiological Section two interesting papers were read, one by Profs. Lodge and Gotch on "Some Physiological Effects of the Passage of Rapidly Alternating Currents of Great Intensity Through Nerve," and the other by Mr. G. J. Burch on the "Production with the Capillary Electrometer of Photographic Records of Currents Produced by Speaking with a Telephone." The Oxford meeting of the Association was concluded in a general meeting held at half-past two in the afternoon, when the Association adjourned. The next meeting will be held at Ipswich.

The largest number of papers in any single section was presented in Section A, but the honors of the session may possibly be claimed by the Chemical Section, in which the chief sensation was the announcement by Lord Rayleigh and Prof. Ramsey of the discovery of a new substance in the earth's atmosphere resembling nitrogen.

Dynamo-Electric Machinery—V.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Fig. 16 shows a duodeci-polar alternator. The wires, a, a, are in circuit with the field magnets, and serve to carry the current which excites them, while the wires, b, b, lead from the brushes.

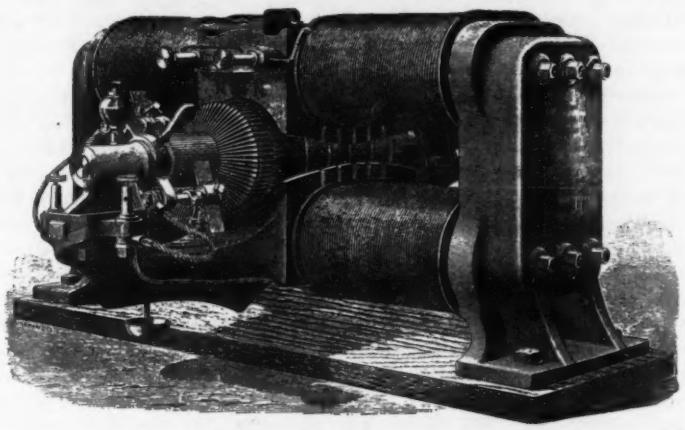


FIG. 14.—CONTINUOUS CURRENT CONSEQUENT POLE BI-POLAR GENERATOR, SHUNT WOUND.

16. Dynamo-electric machines may also be divided, according to their magnetic circuits, into the two following classes:

(a.) Those having simple magnetic circuits formed by a single core and winding,

(b.) Those having consequent poles, or poles formed by a double winding; that is, by the juxtaposition of two poles of the same name. Dynamo-electric machines belonging to the first class are shown in Figs. 1, 3 and 5. A type of machine belonging to the consequent pole class is shown in Figs. 14 and 15. The poles are

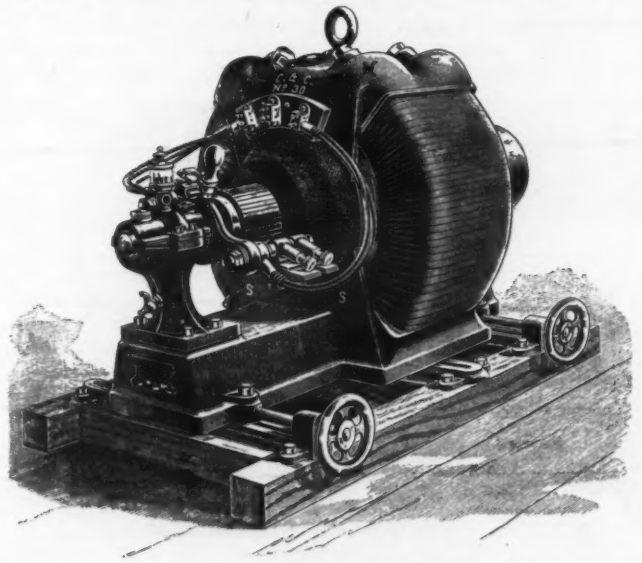


FIG. 15.—CONTINUOUS CURRENT CONSEQUENT POLE BIPOLAR GENERATOR.

shown at N, N and S, S, in each case, the field coils being so wound and excited as to produce this effect.

17. Dynamo machines may also be classified according to the shape of the armature, as follows, namely:

(a.) Ring armatures.
(b.) Cylinder or drum armatures.
(c.) Disc armatures.
(d.) Radial or pole armatures.
(e.) Smooth core armatures.
(f.) Toothed core armatures.

Figs. 2 and 11 represent examples of ring armatures.

Since Gramme was the first to introduce this type of armature, it is frequently called a Gramme-ring armature. Figs. 1, 5 and 14 show examples of cylinder or drum armatures. Disc armatures are very seldom employed in the United States. An example is shown in Fig. 19. An example of a radial or pole armature is seen in Fig. 17.

A smooth core armature is one on which the wire is wound over the cylindrical iron core, so as to completely cover the armature surface; or, if the wire does not cover the surface completely, the space between the wires may either be left vacant or filled with some non-magnetic metal. Such armatures are represented in Figs. 1, 2, 5, 15.

A toothed-core armature, on the other hand, is one on which the

FIG. 16—ALTERNATING CURRENT SEPARATELY-EXCITED DUODECI-POLAR GENERATOR.

wire is wound in grooves or depressions, on the surface of the laminated iron core, so that the finished armature presents an iron surface, but with slots containing insulated copper wire. Such an armature is shown in Fig. 18 and also in Figs. 7, 10 and 11.

18. Dynamos may also be divided according to the actual or relative movement of armature or field, into the following classes, namely:

(a.) Those in which the field is fixed and the armature revolves. This class includes all the machines previously described, except that represented in Fig. 19.

(b.) Those in which the armature is fixed and the field revolves. An example of this type of machine is shown in Fig. 19, where two

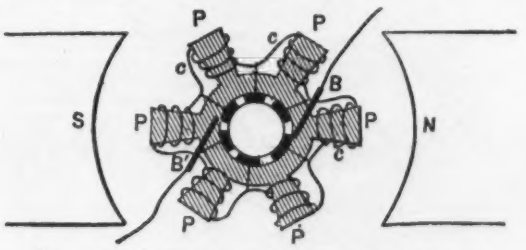


FIG. 17—DIAGRAM OF POLE ARMATURE.

sets of field magnets, mounted on a common shaft, revolve together around a fixed disc armature which is rigidly supported vertically in the space between them.

(c.) Those in which the field and armature are both fixed, but the magnetic connection between the two is revolved. These dynamos are usually called inductor dynamos.

19. Dynamo machines may also be divided according to the character of the work they are intended to perform, into the following classes, namely:

(a.) Arc-light generators.
(b.) Incandescent-light generators.
(c.) Plating generators.

(d.) Generators for operating motors.
(e.) Telegraphic generators.
(f.) Therapeutic generators.

20. Alternating current generators may be divided according to the number of separate alternating currents furnished by the machine in to the following classes, namely:

(a.) Uniphase alternators, or those that deliver a single alternating current. To this class of machines belong all the ordinary alternators employed for electric lighting purposes.

(b.) Multiphase alternators, or those that deliver two or more alternating currents which are not in step.

Some multiphase alternators can supply both single phase and multiphase currents to different circuits.

Multiphase machines may be further sub-divided into the following classes, namely:

(1.) Diphase machines, or those delivering two separate alternating currents. These two currents are, in almost all cases, quarter-

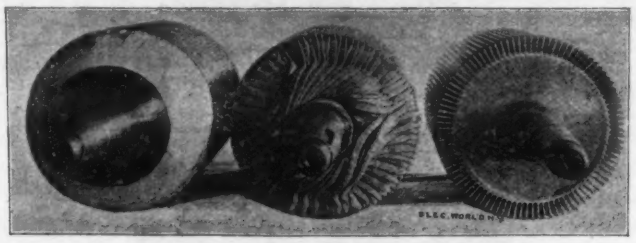


FIG. 18—A TOOTHED-CORE ARMATURE SHOWING THE STAGES OF WINDING.

phase currents, that is to say, they are separated by a quarter of a complete cycle. Such machines, when necessary, may be called diphase-quarter-phase machines. Although it is possible to employ any other difference of phase between two currents, yet the quarter phase is in present practice nearly always employed.

Fig. 9 represents a diphase generator.

(2.) Triphase machines, or those delivering three separate alternating currents. These three currents are, in all cases, separated by one third of a complete cycle.

Uniphase machines sometimesare called single-phase machines, and diphase machines are sometimes called two-phase machines or two-phasers, while triphase machines are sometimes called three-phase machines or three-phasers. The terminology above employed, however, is to be preferred.

21. In addition to the above classification there are the following outstanding types:

(a.) Single-field-coil multipolar machines, or machines in which multipolar magnets are operated by a single exciting field coil.

(b.) Commutatorless continuous current machines, or so-called unipolar machines, in which the E. M. Fs. generated in the armature being obtained by the continuous cutting of flux in a uniform field, have always the same direction in the circuit, and do not, therefore, need commutation. The term unipolar is both inaccurate and misleading, as a single magnetic pole does not exist.

(To be continued.)

Electric Lighting in Great Britain—III.

BY E. RAY STEVENS.

But few of the public plants have been established long enough to judge fairly of the results of operation. Bradford has been operating its plant as long, if not longer, than any other British city. It is now five years since it was established, and figures for the first four years of operation are available. During this period the capital of the plant had been doubled by extensions to meet the increased consumption, which, in 1893, was over 480,000 Board of Trade units, or over four times what it was in 1890.

The gross revenue from the plant has increased from $12,000 in 1890 to $50,000 in 1893. During the first year of operation the plant paid a gross profit of more than $1,500; this surplus last year was $25,000 over and above all the actual expenses of operation. The city has each year set aside a sum for interest, taxes, depreciation and sinking fund, which last year amounted to $16,000.

In order to give a clearer idea of the various items of cost, they have been calculated upon the basis of the standard unit rather than given in a lump sum. The standard unit is fixed by the Board of Trade to be a current sufficient to supply fifteen incandescent lamps of sixteen candle power for one hour. The cost of repairs and maintenance per unit has in the four years been reduced from 1.34c. to .74c., the cost of oil, waste, engine room stores and carbons from .3c. to .12c., wages from 3.46c. to 2.1c., and the cost of coal from 2.18c. to 1.32c. It should be said that coal cost but 92c. per unit in 1892, but that the miners' strike and consequent scarcity of coal caused it to be unusually dear last year. The total cost of production and distribution, including such charges as rents, taxes and office expenses, was in 1890 8.2c. per unit., in 1891 was 5.94c., and in 1892 and 1893 5.14c. The percentage of the total cost to the total revenue has decreased from 85.94 in 1890 to 49.15 in 1893, so that the gross profit last year was over 50 per cent., after paying all operating expenses, yet the price charged is lower than in all the other thirty cities for which figures have been obtained with the exception of four.

Bradford is the only one of these thirty-one cities which does not charge rent for the meters used. The average price charged last year was 10.16c. per unit. This certainly is a very favorable showing for the first four years of operation. But the city suffers from the disadvantage of having purchased machinery which is somewhat inferior to that now manufactured. It will doubtless be compelled in the near future to replace the old machinery by that which is more improved.

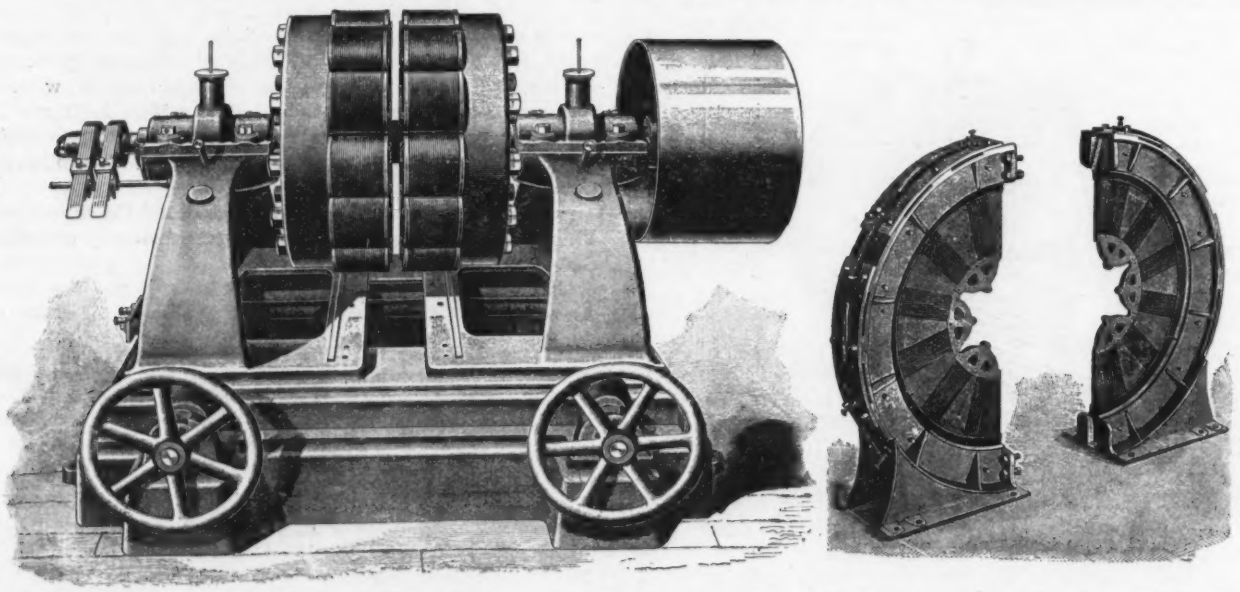


FIG. 19—ALTERNATING CURRENT DOUBLE-DUODECIPOLAR GENERATOR WITH FIXED ARMATURE AND REVOLVING FIELD FRAMES.

Among the other most successful public plants is that of the Saint Pancras Vestry in London, which has a capitalization of $480,000. The gross revenue rose from $55,000 in 1892 to $75,000 in 1893, while the gross profit increased from $12,500 in 1892 to $30,000 in 1893. But the average price for these two years was raised from 11.3c. to 11.68c. per unit. The amount set aside last year for interest, depreciation and sinking fund was $23,000, leaving a surplus of $7,000 on the undertaking. The consumption last year was nearly 595,000 units.

In detail the cost of the coal used was 3.32c. per unit in 1892 and 2.46c. in 1893; the cost of oil, water, carbons, etc., was .68c. per unit

in 1892 and .58c. last year; wages cost 2c. last year, a reduction of .72c. per unit from the previous year; repairs and maintenance cost .38c. in 1892 and 1.18c. last year. The total cost per unit of all expenses of manufacture, distribution and management was 9.32c. in 1892 and 7.1c. last year. St. Pancras, owing, doubtless, to the exceptional conditions of the local government of London, does not pay taxes. But as far as I have been able to learn, this is the only example of a public lighting plant that does not meet its full share of taxes, including those for education and the poor, even though the plant has neither children to educate nor paupers to maintain.

Brighton began to operate its plant in 1892. The consumption, revenue and gross profits of the undertaking were in 1893 nearly double what they were in 1892. The amount of each item of expenditure per unit was reduced except that spent for repairs and maintenance, and the total cost was lowered from 7.52c. in 1892, to 5.92c. in 1893. The average price charged was reduced from 13.96c. to 12.36c. per unit, and the percentage of gross profits rose from 47.56 to 54.03. The consumption last year was 286,895 units.

Glasgow began the operation of a plant last year that had not by the close of the year met running expenses. It is operated in conjunction with the municipal gas plant, and the deficit was met by the profits of that industry. Huddersfield, in July, 1893, began the operation of a model plant equipped almost entirely with American machinery. The revenue of the first six months was over $5,000, which has been doubled during the last half year. This is sufficient to more than meet all expenses of operation, but does not meet the heavy contribution to the sinking fund, which must in thirty years extinguish the debt of $210,000 for establishing the plant.

Among the most successful of the public plants established last year is the one at Manchester, which, during the first eight months of operation, paid all but $600 of the expenses and fixed charges, such as interest and sinking fund. The gross profit was over $23,000. The average price charged was 11c. per unit, and the average total cost 6c. per unit. The present year will show still better returns, for so popular is the light that the present capacity of the plant has been entirely exhausted, despite the fact that it was thought that it would supply all demands for a half decade at least. 439,379 units were consumed during the first eight months of operation. Extensions will be made at once.

Of the other public plants that at Hull made a gross profit during the first year of its operation of $4,400. This, however, was not sufficient to meet all fixed charges, such as interest and sinking fund. The total cost per unit was 10.06c., and the average charge 14.14c. The plant at Dublin paid a gross profit of $7,500 last year. The total cost per unit was 8.18c., and the average charge 9.76c.

The other cities in which public operation of electric lighting plants has recently been begun, or is about to be begun, are Nelson, Bristol, Richmond, Aberdeen, Edinburgh, Accovington, Bedford, Blackburn, Blackpool, Burnley, Burton-on-Trent, Cheltham, Derby, Dundee, Great Yarmouth, Kingston-upon-Hull, Kingston-upon-Thames, Lancaster, Leicester, Nottingham, Oldham, Portsmouth, Salford, Stafford, Walsall, Wolverhampton, Bolton, Worcester, Cardiff, Coventry, Dewsbury, Ealing, Hauley, Londonderry, Newport, Southport, Sunderland, Tunbridge Wells, Halifax, Whitehaven and Taunton. Many other cities have secured the provisional orders, but have not established plants as yet, and still others are now taking steps to secure the necessary orders from the Board. These facts show a rapid increase in the number of public plants in the United Kingdom, which at present is greater than that of private undertaking.

LONDON, England.

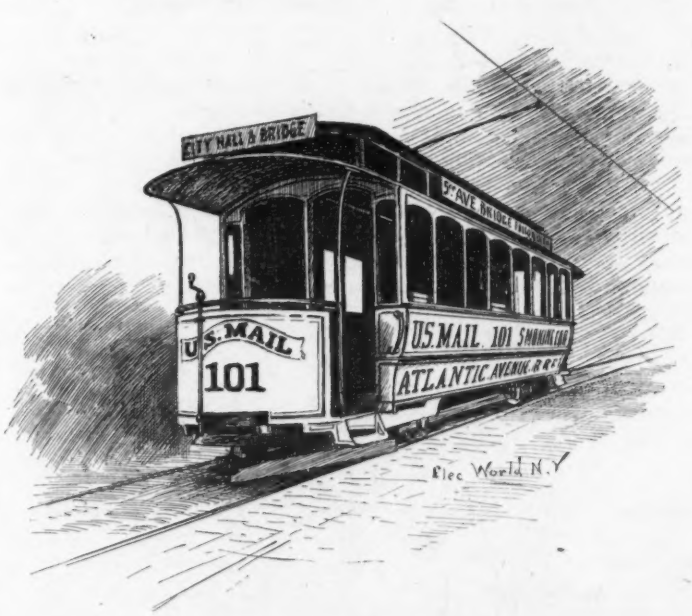
(To be Continued.)

Electric Belts in England

An English court has given judgment to the London "Electrical Review" in the last of several suits brought on by scathing criticism of electric belt venders, in all of which our public-spirited English contemporary has been victorious The present suit was an action for maintenance brought by the proprietors of the "Electrical Review" against one Harness, and the Medical Battery Company, Limited, of which company Harness was managing director. The Medical Battery Company was incorporated for the purpose of carrying out the treatment of diseases by means of electric and magnetic appliances. They manufactured a belt which was thought suitable for such treatment, and, as part of their establishment, they founded and maintained an institution called "The Electropathic and Zander Institute," with Harness at its head. In January, 1892, the "Electrical Review" published an article by way of protest against certain appliances and electric belts which had been publicly exhibited by the company at the Crystal Palace, as being constructed in direct opposition to the most elementary laws of electricity, and in July and September of the same year published other articles against the Institute and against Harness, its president. As a result of these articles the Medical Battery Company brought an action against the journal in September, 1892. The pleadings in that action were completed, but no notice of trial was ever given, and in April, 1893, the action was discontinued. In that same September another article appeared in the "Electrical Review," commenting in very strong and adverse terms upon a report which had recently been written and published by one Dr. Tibbits, testifying to the great value of the institution, its apparatus, appliances and electric belts. The article reflected seriously upon the character and conduct of Dr. Tibbits in connection with that report, and also upon the Zander Institute and its appliances, and the conduct of Harness as its manager and vendor of the belts bearing his name, and Dr. Tibbits, in October, 1892, commenced an action for libel against the journal. The action came on for trial before Mr. Justice Mathew on February 15, 1893, and it resulted in a verdict for the "Electrical Review" on the ground of privileged criticism. The costs of this action Dr. Tibbits was unable to pay, and the last action was brought against Harness and the Medical Battery Company, to recover the damages sustained by the journal, upon the ground that the former unlawfully maintained Dr. Tibbits in bringing and prosecuting his action. Judgment was entered for the "Electrical Review" and a stay denied except in consideration of a deposit of £500 paid into court, or security for that amount.

Mail Service by Trolley.

The transportation of mails by trolley cars was begun in Brooklyn recently, when a trial trip of the new trolley postal car on the lines of road controlled by the Brooklyn Traction Company on the Atlantic



ELECTRIC MAIL CAR.

Avenue and Brooklyn, Bath and West End systems between the Brooklyn post office and Coney Island was made. The route was made a mail route recently by the post office department. The new combination mail car, one half of it fitted up as a mail distribution car and the other half to carry passengers, takes the following route: Adams street, Court square, Boerum place, Atlantic avenue, and Fifth avenue, to Thirty-sixth street, and thence over the route of the West End road, in New Utrecht avenue, to West Brooklyn, Blythebourne, Van Pelt Manor, Bath Beach, Bensonhurst, and Unionville to Coney Island. Mails for all these various post offices are carried and distributed in the car, and at certain points in the city collectors meet the car, and carry the mail to branch post-offices, and deliver what is to be sent to the outlying stations on the outward trip, and to the general post office on the return trip. It is thought that the collection and delivery of mails will be expedited by several hours under the new system. Three trips a day will be made. The car, which is shown in the accompanying illustration, is not an old surface car remodeled as a makeshift for the postal service, but a new one made from designs furnished by Postmaster

Sullivan and by the railway mail department. It is of the regulation size and is divided into two sections by a partition across its centre. The forward half is fitted up for the railway mail service, with iron racks for the pouches, a distributing table extending all along one side for the sorting, separating and stamping of mail matter, and with a set of pigeon holes for distributing. The rear half of the car is to be used by smokers, and it has seats around three sides. The windows of the postal compartment are protected by a wire netting, so that while the windows may be open in warm weather there is no possibility of any of the mail matter being blown out of the windows. All the woodwork that is exposed is of polished maple, and the roof is finished in white enamel with gilt ornaments. The car is lighted by electricity and is also supplied with electric heaters. The outside of the car presents a striking appearance, being finished in white enamel with the lettering in gilt. Running along the side of the mail compartment of the car are the words, "United States Mail," and the smoking compartment is designated by the words, "Smoking Car." In the centre is the number of the car, 101, and along the space just over the wheels are the words, "Atlantic Avenue Railroad Company."

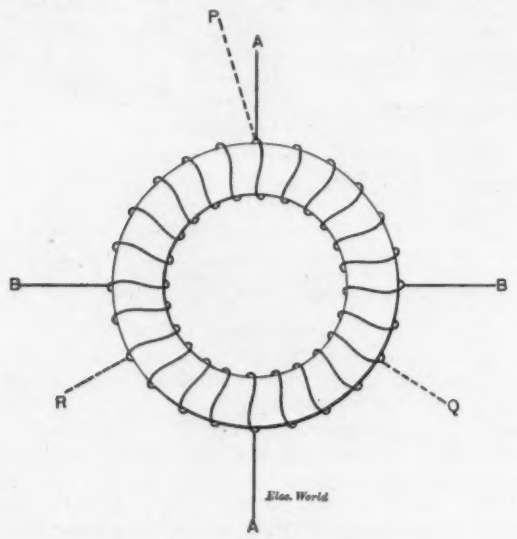
The Wenstrom Company.

The Fort Wayne Electric Company has purchased the Wenstrom Electric Company, of Baltimore, for the purpose, it is reported, of obtaining control of the Wenstrom patents. These patents, it has been claimed, cover some important points in dynamo and motor construction and are generally infringed by manufacturers of electrical machinery. There are rumors that an active fight will be at once begun against all of these alleged infringers.

Some Advantages of Alternating Currents.*

BY S. P. THOMPSON.

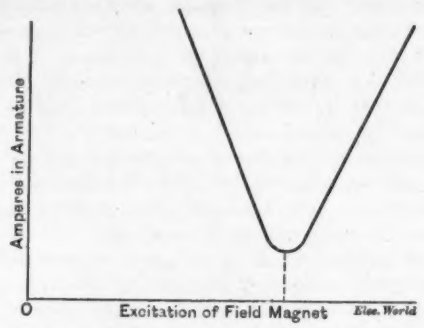
After referring to the advantages of the alternating current for high voltages, and on account of lacking sliding contacts, its greater safety, greater adaptability for regulation and absence of electrolytic effects on insulation, a method somewhat similar to that of Mr. C. F. Scott, is described for transforming three-phase currents into two-phases and vice versa, which was first published in a lecture before the Royal Institution on February 23, 1894, some days in advance of the paper of Mr. Scott, which was read at Washington on March 7, 1894. If a Gramme ring is connected, as shown in the



Phase Transformer.

figure, to a two-phase system with 100 volts between A, A, and 100 volts in quadrature between B, B, a three-phase set of alternating currents may be taken off from the same winding at any three equidistant points P, Q, R, at pressures 66 volts between each of the three wires. The magnetic field across the coil revolves, and it is preferable to provide a luminated core to complete the magnetic circuit. Such a core may be stationary or may revolve. It is no exaggeration to say that an electrical engineer, starting, let us say, with three-phase alternate currents as the method of supply, is in a position to furnish any customer who may desire either two-phase currents or single-phase currents with what he wishes by merely putting in a small appropriately connected transformer.

Another advantage of alternating currents arises in its application to electro-magnets. It has long been known that the magnetic forces of a magnet fall off very rapidly at small distances from their poles. For steel magnets, in those cases in which the poles can be considered as points, the force falls off inversely as the square of the distance, other things being equal. In the case of soft iron electro-magnets operated by continuous currents, the pull on their armatures falls off much more rapidly than this. The forces when in contact may be relatively enormous, and yet the magnet may have no range of attraction worthy of mention. A pull of 150 lbs. in contact may dwindle to a few ounces at a distance of a couple of inches. With alternating currents, however, supplied at constant



Induction Motor Excitation Curve.

voltage from the mains, the author finds all this to be different. With a properly-designed and well-constructed electro-magnet, the pull on its armature can be kept fairly constant over a considerable range; nay, in some cases can be caused to be *greater at a distance than when near*. For example, an alternating current magnet the pull of which, when excited at 50 volts, was 8 oz. when the armature was closely in contact with the core, exercised a pull of 32 oz. when the space between them was 3 inches. This obviously introduces into electric mechanism a new element hitherto undreamed of.

The secret of these things is that in the case of alternating current electro-magnets, the self-inductive reaction of the system also enters, and not merely the electric *resistance* of the wires. Whereas Ohms' well-known law for continuous currents is

$$\text{Current} = \frac{\text{electromotive force}}{\text{resistance,}}, \text{ or } \quad C = \frac{E}{R}$$

The rule that governs the alternating current in these cases is different, being

$$\text{Current} = \frac{\text{electromotive-force}}{\text{impedance}}, \text{ or } \quad C = \frac{E}{\sqrt{R^2 + L^2\omega^2}}$$

where $\omega = 2\pi \times$ the frequency of the alternating current, and L is the inductance. As the armature of the alternating current magnet is withdrawn from the core, the inductive reactance diminishes and more current flows, making the pull greater at a distance instead of less.

Another curious point about alternating current magnets relates to their winding. In the case of electro-magnets supplied with continuous currents, it is well known that the more turns of wire that are wound on the core, the more powerfully is it magnetized. But with alternate current magnets this is not so. There is one particular number of windings for each magnet, generally a small number, for which the magnetism is a maximum, and any additional wire wound on above this number diminishes instead of increasing the magnetic power.

After referring to the inductive drop on alternating current lines and the manner in which it may be counteracted by condensers, it is pointed out that another remedy is possible, which must before long become general when its advantages are known. In 1892 Mr. Mordey gave at the Institution of Electrical Engineers some results of alternating current working, including a very remarkable curve, here reproduced, showing the dependence of the armature current upon the excitation of the field magnets of a synchronous motor when loaded with a given load. To this curve and its meaning the author directed attention at the time, and he has since given much thought to it. It will be found to be most significant. The curve presents the form of a letter V. The lowest point corresponds to a particular state of things, namely: that the motor having its magnetism excited to a particular degree, draws a certain

* Abstract of a paper read before the British Association at Oxford,

minimum amount of current from the mains in order to drive its mechanical load at the speed imposed upon it. But to do the same work—drive the same load at the same speed—will take more current from the mains if the excitation of the magnets is either more or less than this particular amount. This seems very strange, but the explanation and its consequences are no less so. The particular stage of excitation which makes the armature current a minimum for the particular load in question is that stage which corresponds to there being no difference of phase between the pulsations of impressed voltage and those of the resulting current. Suppose, for example, the armature had a resistance of ½ ohm, and that the current was supplied at 100 volts, and that a current of 10 amperes was found the minimum current that would drive the load, it would be found (approximately) that the excitation corresponding to this minimum current would be such as would make the motor work with a back electromotive force of 95 volts; for then, by Ohm's law, $(100 - 95) \div ½ = 10$ amperes. But, now, suppose the excitation is lessened, the machine acting at the same unaltering speed will generate less than 95 volts; suppose it drops to 90 volts. Then, if nothing else happened, the current would increase to $(100 - 90) \div ½ = 40$ amperes. But 40 amperes at 90 volts is much more power than 20 amperes at 95 volts, and is more than is wanted for the load —what must happen? The machine is synchronous, and cannot—physically cannot—run faster so as to take up this power. It tries to do so, with the result that it shifts the phase of its reactions, the current now lagging in phase behind the impressed electromotive force—choked down, in fact, from the 40 amperes to something more than 20—choked down, in fact, to such an amount as would, if multiplied by the cosine of the angle of lag, and by the 90 volts, come up to the same product as the original volts and amperes, namely, $95 \times 10 = 950$. The synchronous motor, *if under-excited*, acts then as a choking coil, producing a reactive drop. But continue the argument the other way: Suppose the excitation is increased so that the 95 volts become 100 volts, when $(100-100) ½ = 0$; and there would be no current at all to drive did not again an adjustment of phases come into play. Instead of the current dropping to zero, more current than before now comes into play, and that current has its pulsations in advance of those of the impressed voltage, there being now an angle of *lead* in the phase relations. In other words, the synchronous alternating motor, *if over-excited*, acts as a condenser, and, instead of producing a drop in the voltage, tends to raise it by compensating the inductive drops due to self-induction in other parts of the circuit. When the importance of this deduction from Mr. Mordey's curve dawned upon the author, he began to prepare to test it upon the mains of the City of London Electric Lighting Company. But before any experiments could be even arranged, he learned that the same conclusions had been arrived at by the officials of the General Electric Company, at Lynn, Mass., and that they had found it in practice to work out favorably. They found that in a line where self-induction played the part of a choking coil, it did not matter very much whether the voltage needed for driving the current through the line and machines were situated mainly in the generator or in the motor, as the mean voltage in the line was not far from a mean between that of the two. Accordingly, in a three-phase power transmission at Hartford, Conn., of 300 kilowatt output, the motor was arranged to be over-excited. Later, after Mr. Steinmetz had submitted the question to calculation, this feature was introduced into the synchronous motors used in all their recent power transmissions, so that by proportioning the armature reaction and the over-excitation to the self-induction likely to arise, the voltages on the circuit remain quite constant, regardless of load, within the limits of the capacity of the machines.

The advantages to be derived from over-excitation have indirectly another advantage—namely, that for single transmission cases the motor and the generator may be designed and constructed as identical machines, instead of the motor being made smaller than the generator. Further, the regulation of the voltages in such a network as that of the City of London Electric Lighting Company, instead of being made more difficult when motors are much used—as was feared by some engineers—will be more easy, provided the motors are of the over-excited synchronous type. For, the acceleration of phase these produce in the current not only tends to compensate for the inductive drop in mains and transformers, but tends to react right back through the system to the generators in the central station, acting on them as a compound-winding would do, and assisting them not only to counteract the inductive drop, but also the ohmic drop, both between the consumers' lamps and the distributing points, and also between these points and the generating station.

So manifest is this advantage that it would seem worth while to erect at one, or possibly more, points of the network, as remote as possible from the generating station synchronous motors over-excited, to act as condensers in compensating the inductive drop; or in the primary circuit also, to furnish the idle currents for magnetizing the transformer primaries.

Electrical Engineering Education.

From a paper on "The Equipment for Electrical Engineering Laboratories," read by Prof. D. C. Jackson before the Society for the Promotion of Engineering Education, and unfortunately too long to reprint in full, we extract the following paragraphs:

In dealing with electrical engineering laboratories, it is assumed that they are attached to an engineering department over which a professor of electrical engineering presides. The electrical engineering department is therefore separated entirely from the physics department, and is coördinate with the other departments of engineering. The practice, at present common in many colleges, of placing the electrical engineering course, with its class room and laboratory instruction, under the direction of the professor of physics, is just as absurd as it would be to devolve upon that professor the instruction in advanced thermodynamics and the design and construction of steam engines. It is equally absurd for the professor of electrical engineering to attempt to teach physics. Proper instruction in physics is essential to the student who is pursuing a course in electrical engineering, and the physics department must be well controlled and supplied with an excellent independent laboratory equipment. In addition to the ordinary general course in physics, the electrical engineering student should gain, during his coursein physics, a common sense grasp of the elementary motions of electricity and magnetism and of the "all pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as galvanometers, bridges, voltameters, amperemeters, voltmeters, etc. Before beginning his work in electrical engineering, the student's knowledge of Ohm's law and its common results should have become almost instinctive. The student should also become acquainted with the theory and practice of photometry. This should all be done in the physics department and the equipment required for the instruction should be controlled by that department. Much of this equipment is quite different from that required by the electrical engineering department, but some of it is useful to both departments and, where students are not too numerous, may be used to some degree in common.

It seems best to arrange the professional electrical studies for the average electrical engineering student in four divisions, in three of which laboratory work must be made an integral part of the instruction in a satisfactory course. The divisions are:—

1st. Electro-magnetism and its applications to special uses, with special reference to dynamos and motors. 2d. Electro-chemistry (including primary and secondary batteries) and electo-metallurgy. 3d. Alernating currents and alternating current machinery, including alternators, transformers, motors, condensers, etc. 4th. The special applications of the preceding divisions in electric light, power, railway, mining, telegraph, telephone and other types of plants. These divisions are of about equal real moment, but the last must be alloted more time in the lecture room than either of the others, though little or no laboratory time or equipment need be directly allotted to it. The equipment that can be made useful in the fourth division is usually of an illustrative nature, and must be a matter of slow growth and collection as the electrical industries progress, rather than of immediate selection.

While higher mathematics is a useful aid in each of the divisions, its limitations as an agent must be carefully shown in the class-room and laboratory. For the purpose of educating the judgment of a student and fully defining the limitations of theories and mathematical deductions, the laboratory is indispensible and the equipment should be selected with this object in continual view. The equipment should be so selected and be of sufficient amount, that as much as one half of the total time spent by the student under the direct instruction of the professors of electrical engineering may be profitably devoted to the laboratory. The equipment, moreoever, should be such that the work may, as far as possible, deal with fixed commercial instruments and machinery, and actually follow the methods of testing and research used in practice. The first three divisions should each be properly represented by a commercial laboratory equipment, in which every principle and operation is illustrated and made useful in every-day instruction

under the direction of a man who has had experience in similar commercial work. The laboratory work must always go hand in hand with the class-room work, illustrating and strengthening the latter. In this way the equipment may be made most effective in the work for which it is designed. It is well to remember that engineering measurements are almost invariably quantitative, and that the results from an engineering investigation which bear fruit are also nearly always quantitative. It is seldom that purely qualitative results may be accepted as satisfactory in engineering work. Therefore the laboratory equipment must be capable of doing quantitative work which is in general of satisfactory commercial accuracy, and which may be made rigorously exact for purposes of exact investigation.

In determining the course of study to be pursued by the electrical engineering undergraduate, upon which the course of laboratory work must depend, it must unfortunately be remembered that he cannot confine his attention to electrical engineering during the whole time given to professional work in his course. He must gain an elementary but practical knowledge of thermodynamics and hydraulics, with an efficient knowledge of their application in steam and water power plants. He must also get a common sense knowledge of the principles underlying the design, manufacture, and selection of machinery. In fact, he must receive a good working knowledge of the problems of the mechanical engineer. Laboratory courses are likely to fail when not properly balanced, on account of a failure to educate the common sense or judgment of students, the students thus leaving college without having gained an all round capacity for practical work and research which is necessary to put them in a fair way to become useful engineers. The knowledege of the electrical engineer must be based on the honest, well-tried mechanical laws, and he must go into a study of all that will aid most in putting him in the way to make a thorough electrical engineer.

Practical Notes on Dynamo Calculation—XV.

BY ALFRED E. WIENER.

c. Bearings.

To determine the size of the armature-bearings, ordinary engineering practice ought to be followed. In machine design, on account of the increased heat generation at higher velocities, it is the rule to provide a larger bearing-surface the higher the speed of the revolving shaft. This rule may, for dynamo shafts, be expressed by the formula:

$$l_b = k_{10} \times d_b \times \sqrt{N}, \quad \ldots\ldots\ldots (82)$$

where l_b = length of bearing, in inches;
d_b = diameter of bearing, in inches, from formula (76);
N = speed of shaft in revolutions per minute;
k_{10} = constant depending upon kind of armature and on output of dynamo. (See Table XLI.)

The numerical values of k_{10} range between .1 and .225 for high speed armatures, and from .15 to .3 for slow speed armatures, as follows:

TABLE XLI.—VALUE OF CONSTANT IN FORMULA FOR LENGTH OF ARMATURE BEARINGS.

Capacity in Kilo Watts.	Value of Constant k_{10}.	
	High Speed Armatures.	Slow Speed Armatures.
Up to 5	.1	.15
" 10	.1	.175
" 50	.125	.2
" 100	.15	.225
" 500	.175	.25
" 1,000	.2	.275
" 2,000	.225	.3

Applying these values to formula (82) and using the journal diameters previously determined, the following Tables XLII., XLIII. and XLIV. are obtained, giving the sizes of bearings for drum-armatures, high-speed ring armatures and slow speed ring armatures respectively:

d. Pulley and Belt.

The pulley diameter is determined by the speed of the dynamo and the linear belt velocity:

$$d_p = \frac{12 \times S_b}{\pi \times N} = 3.7 \times \frac{S_b}{N}; \quad \ldots\ldots\ldots (83)$$

d_p = diameter of pulley, in inches;
S_b = belt speed, in feet per minute, see Table XLV.;
N = speed of dynamo, in revs. per minute.

TABLE XLII.—BEARINGS FOR DRUM ARMATURES

Capacity in Kilo-Watts.	Value of Constant k_{10}.	Speed in Revs. per Min. (from Table VIII.) N.	Size of Bearing.		
			Diameter (from Table XXXVIII.) d_b	Length $l_b = k_{10} \times d_b \times \sqrt{N}$.	Ratio $l_b : d_b$
.1	.1	3,000	1	1	5.3
.25	.1	2,700	1	1⅛	5.2
.5	.1	2,400	1	2⅛	4.9
1	.1	2,200	1	2⅜	4.7
2	.1	2,000	1¼	3⅛	4.5
3	.1	1,900	1⅜	4	4.3
5	.1	1,800	1⅞	4¾	4.2
10	.1	1,700	1⅝	6¾	4.2
15	.105	1,600	1⅞	7⅞	4.2
20	.11	1,500	2⅛	9	4.2
25	.115	1,350	2⅜	10	4.2
30	.12	1,200	2½	10½	4.2
50	.125	1,050	3	12	4.0
75	.13	900	3⅝	14	3.9
100	.14	750	4⅛	15¾	3.8
150	.15	600	4¾	17½	3.7
200	.16	500	5¼	18¾	3.6
300	.175	400	6	21	3.5

TABLE XLIII.—BEARINGS FOR HIGH SPEED RING ARMATURES.

Capacity in Kilo-Watts.	Value of Constant k_{10}.	Speed in Revs. per Min. (from Table IX.) N.	Size of Bearing.		
			Diameter (from Table XXXIX. d_b	Length $l_b = k_{10} \times d_b \times \sqrt{N}$.	Ratio $l_b : d_b$
.1	.1	2,600	¼	1¼	5
.25	.1	2,400	⅜	1⅞	5
.5	.1	2,200	½	2⅜	4.75
1	.1	2,000	⅝	2¾	4.4
2.5	.1	1,700	1	4¼	4.1
5	.1	1,500	1⅜	5⅜	3.9
10	.11	1,250	1¾	6¾	3.85
25	.12	1,000	2⅝	10	3.8
50	.13	800	3½	13	3.7
100	.15	600	4¾	17½	3.7
200	.16	500	6⅛	23	3.6
300	.17	450	7½	27	3.6
400	.175	400	8½	30	3.5
600	.18	350	10	33½	3.35
800	.19	300	11	36	3.3
1,000	.2	250	12	38	3.2
1,500	.21	225	14	45	3.2
2,000	.225	200	16	51	3.2

TABLE XLIV.—BEARINGS FOR SLOW SPRING RING ARMATURES.

Capacity in Kilo-Watts.	Value of Constant k_{10}.	Speed in Revs. per Min. (from Table X.) N.	Size of Bearing.		
			Diameter (from Table XL.) d_b	Length $l_b = k_{10} \times d_b \times \sqrt{N}$.	Ratio $l_b : d_b$
2.5	.15	400	1⅛	3⅛	3
5	.16	350	1½	4½	3
10	.17	300	2	5⅞	2.9
25	.18	250	3¼	8¾	2.8
50	.19	200	4¼	11½	2.7
100	.20	175	5¾	15¼	2.65
200	.21	150	7¾	20	2.6
300	.23	125	9⅛	23¾	2.6
400	.25	100	10	25	2.5
600	.265	90	12	30	2.5
800	.27	80	13½	32½	2.4
1,000	.28	75	15	36	2.4
1.500	.29	70	18	43½	2.4
2,000	.30	65	20	48	2.4

TABLE XLV.—BELT VELOCITIES FOR HIGH SPEED DYNAMOS OF VARIOUS CAPACITIES.

Capacity in Kilo-watts.	Belt Speed in Feet per Minute. S_b
Up to 5	2,000 to 3,000
2.5 " 25	3,000 " 4,000
10 " 100	4,000 " 5,000
50 " 500	5,000 " 6,000

The belt-speed in modern dynamos ranges between 2,000 and 6,000 feet per minute, as above:

The pull at the pulley circumference, in pounds, is:

$$F_p = \frac{33{,}000 \times \text{h.p.}}{\frac{d_p \times \pi}{12} \times N} = \frac{33{,}000 \times \text{h. p.}}{S_b} = 44.2 \times \frac{W}{S_b}$$

For an arc of belt contact of 180°, which can safely be assumed for dynamo pulleys, the pull, F_p, is to be multiplied by 1.4 in order to obtain the tension on the tight side of the belt; hence the greatest strain upon the belt:

$$F_b = 1.4 \times F_p = 62 \times \frac{W}{S_b}$$

Allowing 300 lbs. per square inch as the safe working strain of leather, the necessary sectional area of the belt can be found from

$$b_b \times h_b = \frac{F_b}{300} = .2 \times \frac{W}{S_b}; \ldots\ldots\ldots (84)$$

b_b = width of belt, in inches;
h_b = thickness of belt, in inches;
W = capacity of dynamo, in watts;
S_b = beltspeed, in feet per minute, Table XLV.

The approximate thicknesses for the various kinds of belts are:

Single belts..... $h_b = \frac{3}{16}$ in.
Light double belts ..... " $= \frac{9}{32}$ "
Heavy double belts..... " $= \frac{11}{32}$ "
Three-ply belt..... " $= \frac{7}{16}$ "

Inserting these figures in (84), the width of the belt is obtained:

Single belts..... $b_b = \frac{.2}{\frac{3}{16}} \times \frac{W}{S_b} = 1.1 \times \frac{W}{S_b}$ ....(85)

Light double belts... $b_b = \frac{.2}{\frac{9}{32}} \times \frac{W}{S_b} = .7 \times \frac{W}{S_b}$ ....(86)

Heavy double belts.. $b_b = \frac{.2}{\frac{11}{32}} \times \frac{W}{S_b} = .6 \times \frac{W}{S_b}$ ....(87)

Three-ply belts..... $b_b = \frac{.2}{\frac{7}{16}} \times \frac{W}{S_b} = .45 \times \frac{W}{S_b}$ ....(88)

Single belts are used for all the smaller sizes, up to 100 kw. output, light double belts up to 200 kw, heavy doubles up to 400 kw., and three-ply belts for capacities from 400 kw. up.

Based upon the above formulæ the author has prepared the following Table XLVI., from which the belt dimensions for various outputs and for different belt speeds can readily be taken:

TABLE XLVI.—SIZES OF BELTS FOR DYNAMOS.

Capacity of Dynamo in Kilo-Watts.	Thickness of Belt, Inch	Width of Belt. Belt Speed, in Feet per Minute 2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000
		inches	inches	inches	inches	inches	inches	inches	inches	inches
1	Single Belt 3/16	.6	.5	.4	..	..	..	..	..	..
2	3/16	1 1	.9	.7	..	..	..	..	..	..
3	3/16	1.7	1.3	1.1	1.0	.8	..	..	..	..
5	3/16	2.75	2.2	1.8	1.6	1.4	..	..	..	..
7.5	3/16	4.1	3.3	2.75	2.4	2.1	..	..	..	..
10	3/16	5.5	4.4	3.7	3.1	2.75	2.5	2.2	..	..
15	3/16	8.25	6.6	5.5	4.7	4.1	3.7	3.3	..	..
20	3/16	11.0	8.8	7.3	6.3	5.5	4.9	4.4	..	..
25	3/16	..	..	9.2	7.9	6.9	6.1	5.5	..	..
30	3/16	..	..	11.0	9.5	8.25	7.3	6.6	..	..
40	3/16	..	..	14.7	12.6	11.0	9.8	8.8	..	..
50	3/16	..	..	18.3	15.75	13.75	12.25	11.0	10	9.2
60	3/16	..	..	22.0	18.9	16.5	14.7	13.2	12	11.0
75	3/16	..	..	27.5	23.5	20.5	18.5	16.5	15	13.75
100	3/16	..	..	..	..	27.5	24.5	22	20	18.5
150	Double Belt. 9/32	..	..	..	..	26.2	23.5	21	19	17.5
200	9/32	..	..	..	..	30.0	26.75	24	21.8	20
250	9/32	..	..	..	..	37.5	33.5	30	27.5	25
300	9/32	..	..	..	..	45	40	36	32.75	30
400	3 Pl. 7/16	..	..	..	..	45	40	36	32.75	30
500	3 Pl. 7/16	..	..	..	..	56.5	50	45	41	37

The width of the belt being thus determined, the breadth of the pulley-rim is found by adding from one-half to two inches, according to the width of the belt.

(To be continued.)

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—I have been watching with much interest the discussion that has been carried on for the last two or three weeks in your columns regarding the practical importance of a true sine curve in alternating current work.

I became personally deeply interested in the matter during my work on induction motors, and conducted, last year, some experiments to determine the actual practical bearing of the difficulties indicated by theory. Of these latter there can be no reasonable doubt, as the demonstration has been thoroughly given by Rowland and others.

The questions that appeared for solution were: (1) Does a wide departure from a sine curve in an alternating current cause such serious effects as to practically interfere with the successful operation of induction motors? (2) If the difficulty really exists practically, how far will it appear in alternators as generally constructed?

These questions were not of theory, but of fact. To answer the first one, my experiments took the following form:

I set up a 15 h. p., three phase induction motor, the properties of which were well known to me. Two sources of power were prepared, either of which could be easily shifted in the motor line by throwing the switch. One of these was a smooth-core three-phase generator, worked at high magnetization, the curve from which had been obtained and was known to be a very close approximation to a sine wave. The other was an iron-clad generator, the curve of which was never exactly a sine wave, and which was deliberately distorted by greatly weakening the field and allowing the armature reaction full play. By suitable banks of transformers, power was delivered to the motor at the same voltage from each machine. I then had a careful efficiency curve of the motor taken, involving a large number of readings, which were obtained from the two currents alternately. The conditions of operation of the motor, which was loaded by being belted to a direct current generator, were thus exactly the same, except in the form of current wave delivered. The result of this experiment showed very distinctly that the sine-wave current had the advantage. The differences observed were not great, but were quite unmistakable. That they were no larger is very likely due to the fact that the third harmonic, usually the most important one, tends to help the armature of the three-phase type of motor.

Having settled this question, I next took up the bearing of the answer on commercial machines. From previous and subsequent experiments with the same motor, I found that the result obtained from the known sine wave did not vary within the limits of experimental error from those obtained by using our ordinary iron clad three-phase generators under commercial working conditions. These experiment were the basis of the statement which I made last winter in a paper before the American Institute of Elecrical Engineers, to the effect that so far as practical operation was concerned, no serious difficulties were to be apprehended from variations from the sine wave such as would be found in good commercial machines. This position I believe to be correct, certainly so far as three-phase apparatus is concerned.

The experiences of Mr. Scott and Mr. Kelly confirm mine as regards the bad effect of wide variations. The trouble which they seem to have had with the commercial machines is, however, much greater than I have ever been able to find even when looking for it, posssibly owing to a worse current curve than I ordinarily obtained, or to difficulties inherent in the motors.

I may casually add that condensers would be very unfavorably affected by variations from the sine wave.

To sum up, I think I can safely say from the concurrence of experiments conducted on the three types of induction motors manufactured in this country, that *considerable* variations from the theoretical form of current wave are serious in their effects. I believe that we also may conclude that in most polyphase generators, even those designed without great attention to the form of wave, no variations of much practical importance are likely to be found. This is certainly true with respect to the three-phase type. I think the effect of an irregular current curve is more to be dreaded, commercially speaking, on the line than in the motors, especially in long distance transmission.

I fancy that the somewhat radical opinion expressed in the London "Electrician" was due merely to unfamiliarity with induction motors, and not to any ignorance as to the theoretical questions involved.

Chicago, Ill. LOUIS BELL.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Starting an Arc.—A new method of Mr. Belloc is described in "L'Elec." August 4 and "La Lum. Elec.", July 28; the arc is started by means of sparks from an influence machine whose poles are connected to the points between which the arc is formed; if sufficiently powerful, sparks will be formed even though the air gap is shunted by the battery or dynamo; he gives the maximum distances for a 50 volt battery for carbon, copper and zinc, the greatest being 3.5 mm. for the latter when unlike poles of the two sources are connected, and least for carbon; with a 4-plate Holtz machine the distance can be as much as 7 to 8 milimeters with zinc terminals.

Atmospheric Electricity and Solar Radiation.—A translation of an article by Messrs. Elster & Geitel from "Wied. Ann.," No. 48, p. 338, on "Observations on the Gradient of Atmospheric Potential and on the Radiation of Ultra-violet Light from the Sun," is given in abstract in the Lond. "Elec.," August 10.

Form of Periodic Currents.—An Academy paper by Mr. Janet, describing an electro-chemical method for recording the forms of curves, is given in "L'Ind. Elec.," August 10.

Specific Inductive Power of Wires.—An Academy note of a theoretical character by Mr. Beaulard, is published in "L'Ind. Elec.," August 10.

Mechanism of Conduction.—"La Lum. Elec," August 4, publishes an article of some length by Mr. Blondin, based on the article of Mr. Burton in the "Phil. Mag." for July.

Work of Hertz.—In a note by Dr. Lodge in the Lond. "Elec.," July 27, he regards as the special discovery of Hertz the transmission of electric waves in free space; their transmission along wires was noticed by Von Bezold in 1870 and by Lodge in 1887.

Elliptically Polarized Electric Radiation.—A note by Dr. Lodge is contained in the Lond. "Elec.," August 3.

Equation of Discharge.—An Academy note by Mr. Swyngedauw, is published in "L' Ind. Elec.," August 10.

MAGNETISM.

Heating of Magnet Coils.—In a short article by Mr. Mueller in the "Zeit. feur Elek.," June 15, he gives a table of the current density in the wire, the rise of temperature after five hours and the percentage increase of speed necessary to keep the difference of the potential constant; the results were obtained by experiment from a coil containing 21 layers of 2.5 m. wire; experiments with coils of wire of other sizes showed a difference of only 1 to 2 per cent., and he therefore concludes that the table which he gives can be used for a wide range.

Forces in Magnetic Circuits.—The Lond. "Elec. Rev.," August 10, notices a paper by Prof. Threlfall in the "Phil. Mag." for July, recommending it as an important paper to those who have occasion to design reciprocating electro-magnetic mechanisms. The same paper is abstracted at some length in "La Lum. Elec.," July 28; the theory of Maxwell that the magnetic forces are due to the ether tension is discussed.

The Law of the Magnetism of Iron.—In "L'Ind. Elec.," August 10, Mr. Gulmann discusses Froelich's recent paper (see Digest August 4), in which he claims to have found the law; Mr. Culman showed that this law gives very incorrect results for high degrees of magnetization; for values of H above 385 the results differ more and more from those obtained by experiment; he compares the calculated values with those obtained by several experimenters.

Terrestrial Magnetism.—Prof. Rucker's presidential address to a section of the British Association is published, apparently in full, in the Lond. "Elec.," and "Elec. Eng," August 10, and is devoted almost entirely to terrestrial magnetism.

Magnetic Perturbation.—An Academy note by Mr. Monreaux describing a recent very large perturbation, is published in "L'Ind. Elec.," August 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Magnetic Qualities of Iron.—A letter from Dr. Koepsel regarding his instrument, mentioned in the Digest, July 28, is published and discussed editorially in the Lond. "Elec.," July 27; he states that the suggestion to make it a torsional reading instrument would not do away with the compensation windings, as these do not neutralize the effect of the movable coil, which is practically nothing; they are intended to neutralize the magnetic effect of the fixed magnetizing coil, thus measuring $\mathfrak{B}$ alone, instead of $\mathfrak{B} + \mathfrak{H}$, a torsional apparatus would not have the advantages of a direct reading instrument. (The apparatus was mentioned in the Digest, May 12, and described under another name in "The Electrical World," Feruary 24, page 236.)

Instrument for Measuring Permeability—"La Lum. Elec.," July 28, gives a short illustrated description of the apparatus of Knapp & Sprong. It consists essentially of a horseshoe magnet, and a peculiarly shaped pivoted armature between its poles attached to a pointer and moving against the action of a deflecting spring; the instrument is applied by placing the two poles on the piece of iron to be measured, stops being provided to keep the distance from the magnet to the iron the same; the iron therefore magnetically shunts the armature and the diminution in the deflection of the pointer is therefore an indication of the permeability of the iron, the sale having been calibrated empiracally.

Testing Thermometers.—According to the Lond. "Elec. Rev.," July 27, the method used at Owens College, with which much greater accuracy is obtained, consists in heating the bath containing the thermometers by means of another bath surrounding it, in which the heat is generated by a coil of platinum wire.

Photometry.—The first of Captain Abney's Cantor lectures, abstracted in the Digest April 28 and May 12, is published in abstract with illustrations, in the Lond. "Elec., Eng.," July 27.

Government Calibrating Laboratory.—The laws and rules regarding the new department which has just been established by the Austrian Government for the calibration of electric meters, are published in the "Zeit. feur Elek.," August 1.

International Ohm.—The Lond. "Elec. Rev.," August 3, calls attention to the fact that the ordinary forms of the Wheatstone bridges can be made to measure the ohm, as adopted at present, by the simple expedient of adjusting the coils in one of the ratio arms, so that instead of having equal values, they have values in proportion of the former ohm and the new ohm.

Capillary Electrometer.—An inprovement by Mr. Gouy, intended to make the instrument more precise and easier to use, is described in "La Lum. Elec.," August 4. (An improvement was described in Digest, May 12).

DYNAMOS AND MOTORS.

Elementary Theory of the Induction of the Alternating Motor.—Mr. Kennedy begins a series of articles in the Lond. "Elec. Rev.," August 10; the theory is borne out by actual facts and includes no mathematics. Discussing first single-phase motors, he uses, as an illustration, an Arago copper disk, revolving in front of two alternating electro-magnets; he shows that the rotation is caused by the action of the inducing and the induced currents on one another, and that it depends on the lag between these two currents; such a motor must be started before it will rotate by its own action; he shows how it can be started by placing semi-circular copper disks between the rotating disk and the poles, the copper pieces thus screening off half the poles; after the motor is started these copper poles may be removed.

Sine Curve Alternator.—"La Lum. Elec.," July 28, in referring to the large alternator of the General Electric Company, in which it is claimed that the currents are perfectly sinusoidal, considering this of too little importance, and asks what they will be after having been "filtered" by the transformers.

Increasing a Dynamo Current.—According to the "Zeit. feur Elek.," July 15, Mr. Burnowsky proposes to wind a ring armature with the three windings, each with a commutator; the current from a few cells is led into the inner winding; when the armatures revolve poles will be formed, which induce currents in the second winding and part of these pass to the third winding, thus "producing an increased magnetic field," which in turn increases the current in the armature.

TRANSFORMERS.

Current Rushes in Transformers.—Mr. Hay's serial is concluded in the Lond. "Elec.," August 10; he states that the phenomena is a very frequent and general one and that cases in which there is no distortion are the exception with moderately high degrees of magnetic induction, from 2000 C. G. S. units upwards, as used in modern transformers, the initial state of the iron very materially influences the amount of the rush; it has been stated that current rushes do not occur at high periodicities, but in his experiments the frequency was rather high, namely, 122; under ordinary conditions, with more or less slow acting switch, current rushes may be reduced to a large extent, by increasing the fre-

quency. In conclusion he describes, with the aid of some illustrations. the special switching arrangement which he used in his experiments.

Transformer Systems.—A correspondent to the Lond. "Elec. Rev.," and "Elec. Eng.," August 10, points out that the automatic switch in the Lowrie system (see Digest last week) which is the main feature in the system, is not likely to work at all, and he suggests that a simple working experiment be made.

Transformers.—The translation of the German article by Mr. Korda, mentioned in the Digest, July 21, is given in abstract in "La Lum. Elec.," August 4.

ARC AND INCANDESCENT LIGHTS.

Decorative Use of IncandescentLamps.—The Lond. "Elec.," July 27, abstracts a short article from a forthcoming work of Dr. Fleming on "Electric Lamps and Electric Lighting." He shows the importance of concealing the source of light itself, on the ground that the illuminating power of light for the purpose of vision does not depend merely on the candle-power of the lamp but on the amount of light which is received by the eye from the surfaces from which it is reflected; the area of the pupil of the eye varies from about one 150th to one 10th part of a square inch, and if exposed to bright lights it may contract so much that the effective illumination of objects is diminished; although lamp globes of frosted glass may cut off from 30 to 50 per cent. of light, the actual visual effect may, in spite of this, be increased. The proper method is to place the incandescent lamp so that no light from the filament can enter the eye directly, and that it shall reach it only after reflection from the surfaces of the various objects in the room. Bare and uncovered lamps, especially if suspended half-way down or slightly above the level of the eye, form an exceedingly disagreeable method of illumination and ought never to be permitted in any cases where a decorative effect is desired; a natural shell forms a very effective screen and reflecting surface, especially if slightly translucent. A second important principle is to distribute the light properly and to prevent its concentration in large masses, thereby avoiding the production of harsh shadows; a simple test of the effectiveness of the distribution is to hold a white sheet of paper horizontally above the level of the eyes and a pencil vertically to it; if any marked shadows are produced the light is sufficiently diffused and the lamps should be rearranged. The third guiding principle is to proportion the light to the nature of the surfaces from which it is reflected; dull walls reflect only about 20 per cent., light tints of wall paper or paint may reflect from 40 to 60 per cent, clean white surfaces, as varnished wood or plaster, may reflect as much as 80 per cent. and mirrors from 80 to 90 per cent.; he gives the table of Dr. Sumpner, published in the Digest, March 4, 1893 (see also "The Electrical World" March 18, page 205). Rooms with dark woodwork, dark paintings, hangings, curtains, etc., may require from two to three watts per square foot of floor surface, while one with very light decorations, water-color paintings, mirrors, etc., about three quarters of one watt may be assumed, the lamps being supposed to be about 8 or 9 feet above the floor; these figures however, cannot be taken too absolutely; as a broad general rule, 100 square feet of floor surface will be barely illuminated by 16 c. p. lamp 8 feet above the floor, well illuminated by two such lamps and brilliantly illuminated by four, on the assumption that the lamp is 8 feet above the floor and that the floor surface is fairly reflective. (For articles on similar subjects see Digest, July 15, '93, Guy; September 23, '93, Preece; April 15, '93 and the article on lighting," August 11, '94).

Lighting.—A translation of the article abstracted in the Digest, August 11, is published in the Lond. "Elec. Rev.," August 10.

Mensing Arc Lamp.—This lamp is described in the Lond. "Elec. Rev.," August 10; it is based on the action of a band brake; the lamp is simple, short, compact and cheap and can be used for alternating currents.

ELECTRICAL RAILWAYS.

High Speed Railroading.—Under the heading "The Boynton Bicycle Railroad," the Lond. "Elec. Rev." discusses this system and high speeding railroading in general; regarding the Boynton system, it believes that there is lack of novelty in the invention, that the cost of the superstructure will probably be very high and that it is beset with the same insuperable difficulties as other schemes in the rounding of curves; it can see no difference between this system and that of Mr. Danchell, which was tried in 1883. Extracts are made from Sabine's tables regarding air resistance, in which he thinks that the resistance of a vertical flat surface is proportional to its area and the square of the speed; with 150 miles an hour his table gives about 40 horse-power per square foot; Smeaton's rule gives 45 h. p.; it is claimed by some that at high velocities the resistance becomes practically constant, which is thought to be borne out by experiments on trains in actual service; notwithstanding this it believes that it is not easy to obtain 150 miles an hour; some apparent errors in the description of the Boynton system are pointed out.

Accumulator Traction.—According to "La Lum. Elec.," August 4, the experience in Paris has shown the cost of electric traction to be 10.6 cts. per car-kilometer and that of animal traction 11.2 cts. per car-kilometer; this does not seem to include repairs; on the accumulator line, the traffic, the speed and the comfort of the passengers were greater and the stoppages were made more quickly.

Heilmann Locomotive.—The French railroad company which is experimenting with the Heilmann locomotive, has, according to "L'Ind. Elec.," August 10, ordered two new locomotives embodying improvements and modifications; they will have Willians engines of 1,500 h. p. each; it is expected that the tests will take place in May of next year.

Submarine Navigation.—The Lond. "Elec. Rev.," in an editorial in the issue of August 10, states that the future of submarine navigation lies in the hands of electrical engineers; compressed air is not suitable on account of the excessive weight of the reservoirs and on account of the great cold produced during expansion; it adds that no system of electric accumulator has yet been discovered, which is perfectly adapted to the needs of submarine navigation.

Liverpool and South London Railways.—Some comparative figures for the Liverpool Overhead and the City and South London Underground railways are given in the Lond. "Elec." August 3; the "loco" expenses per train mile, not including salaries and wages for repairing work, were 5.5 and 11.5 cts. per train mile respectively.

South Staffordshire Railway.—The working results, together with some comparative statements of the cost per car mile for running and repairs of this and several other roads in England, are given in the Lond. "Elec. Eng.," July 27.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Train Lighting.—In the "Elek. Zeit.," August 2, Mr. Bruun gives a very complete description, with illustrations, of the system which is being used at present on some express trains in Denmark. Experiments were tried some time ago during a period of nine months, and as they were so successful the present more extended plant has been installed for making further tests; the conditions are favorable, as the lighting is only during four hours and the trains are at the stations for 8 or 10 hours during the day; in order that a car may be removed without extinguishing the light, the train is provided with a double system of wiring and a battery in the first and last car; the car wiring and some of the details are illustrated. In the detailed estimates of the cost, which are chiefly of local interest, an allowance of 30 per cent. has been made for maintenance, amortisation and interest on the accumulators, and 10 per cent. for the rest of the installation, not including the replacing of the lamps; the estimated total cost of operation is about one-third (.38) of the total cost; the total cost of operation per candle per hour is given as 0.154 cents. No definite figures are given for comparing these with the cost of the gas lighting formerly used, but it is stated that the costs of the electric lighting are certainly not greater than those of gas lighting, in which the gas is obtained from oils, and that probably it will be found to be cheaper.

London.—The Lond. "Elec.," August 10, announces that the London Electric Supply Corporation (using the Ferranti 10,000 volt system) has passed into the hands of a receiver; $4,250,000 were sunk in this undertaking.

WIRES, WIRING AND CONDUITS.

Spans of Soft Copper Wire.—In an article by Mr. Herzog in the "Elek. Zeit.," August 9, he discusses theoretically the various factors and relations entering into the calculation of the stretching of soft copper wires between poles for overhead lamps. He deduces a very simple method for calculating the various factors graphically: the diagram consists of sets of curves on cross-section paper giving the relations between the temperature of the wire, the distance between the points of support, the sag and the specific tension, that is, the tension per square millimeter of cross-section; by means of this table any one of the factors can be found directly when the others are given. (The table is in meters, centigrade degrees, kilograms and square millimeters, but it can readily be converted into the units used in this country, without redrawing all the curves, by simply inserting the equivalents of the various figures on the table itself. In the form given the table seems to be a very useful one and it facilitates calculations very greatly.)

Mains.—The Lond. "Elec. Rev.," August 10, in an editorial, suggests that the vexed question of the most suitable system of mains for electric lighting should be thoroughly threshed out by a parliamentary commission; it appears to argue in favor of vulcanized rubber.

Armored Flexible Conductor.—An illustrated description of a double conductor is given in "Ind. & Iron," July 27.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Automatic Telephone Switchboard.—The automatic system of Mr. Nissl, in which each subscriber can call any of the others (see Digest, June 2), is described at some length in the "Elek. Zeit.," August 9, and in the "Zeit. feur Elek.," June 15; the description includes a large complete diagram of the connections.

Morse Relays as Telephones.—According to the "Zeit. feur Elek.," August 1, it was noticed that under certain circumstances the Morse relays, which were connected in the telephone circuit, acted as telephones; speech was distinctly audible, especially if the ear was placed on the table on which the relay was secured.

The Lebedinsky system is briefly described in the "Zeit. feur Elek.," August 1; by means of it a train while at rest may communicate with a station by connection with the lines running along the road; the system is to be introduced on a Russian railway.

Telegraphing and Telephoning Over the Same Line.—In the "Elek,

Zeit.," August 2, Mr. Christiani describes, with the aid of some good diagrammatic cuts, a complete system for telegraphing and telephoning over the same line, but apparently not simultaneously, in which none but the Morse and telephone apparatus at present in use in Germany, are required.

Telephone vs. Telegraph.—According to the Lond. "Elec.," July 27, the English post office authorities are introducing telephones for telegraph purposes all over the country.

Telephone in France.—Comparative statistics of the years 1889 and 1894, are given briefly in "L 'Elec.," July 21. (This covers the period during which the Government controlled the telephones.)

Indicating the Departure of Trains.—An apparatus for indicating the departure of trains from stations is described and illustrated in "L 'Elec.," August 4.

Lightning Arrester for Telephone Circuits.—Mr. Engelmann, in the "Elek. Zeit.," gives an illustrated description of a new form of sawtooth lightning arrester.

ELECTRO-CHEMISTRY.

Purification of Water.—The Villon system is described briefly in the Lond. "Elec. Rev.," August 10; nitrate of soda is added in quantities equal to the magnesium and calcium salts in the water; a current is passed between lead electrodes, which forms precipitates which quickly settles; no traces of the reagents remains in the water; about 250 litres an be purified in one hour in the experimental plant; the most extensive experiments refer to the treatment of 20 cubic-meters per day at the cost of one per cent. per cubic meter.

Manufacture of Oxygen and Hydrogen.—A process for the commercia manufacture of oxygen and hydrogen, with the aid of electrolysis, by Prof. Latschinow, is described at some length in the "Zeit. feur Elek.," June 15, July 1 and July 15; it includes a number of illustrations of the apparatus.

Electrolysis of Sulphate of Copper.—An Academy note by Mr. Chassy regarding the nature of the deposit under various conditions, is published in the 'L'Ind. Elec.," August 10.

Electro-deposition of Iron.—"La Lum. Elec.," July 28, contains some data and receipts.

MISCELLANEOUS.

Magnetic Clutches and Brakes.—The article on "Magnetic Chain-Towing" abstracted in the Digest last week, is concluded in "La Lum Elec.," July 28. Applications of magnetic adherence apparatus to traction canals and to friction clutches, are given, including the illustration of the latter which was published in the Digest March 11, 1893; some tables of tests with magnetic brakes are given, and it is estimated that an expenditure of 40 watts per brake at 80 volts would suffice for the greatest braking effort that would be required for the heaviest cars or the fastest trains, on the basis of a single brake for each shaft. Experiments show that a friction clutch about 2 ft. mean diameter at 200 revolutions will transmit 80 h. p. with a current of 0.6 amperes for the brake (the voltage is not given); in another case a steel clutch, 6 ins. mean diameter at 600 revolutions, transmitted 48 h. p. with an expenditure of 225 watts.

Crane.—An electric overhead traveling crane, devised by Messrs. Bollinex, is described and illustrated in the Lond. "Elec. Eng.," August 3. Continuous current and a separate motor for each movement, are used.

Modern Telephone Exchange Practice.

BY J. E. KEELYN.

An evolution in telephone practice is prospective, and the improved system for telephone service for the immediate future will undoubtedly be a radical one from the system which is now in vogue. The new and independent telephone companies will be in the position of adopting all the innovations that come up, and naturally they will not be slow to take advantage of them.

The most important feature of telephone practice, the feature that concerns alike the electrical fraternity, the telephone exchange investor, and the subscriber, is that of charging for service, and it is well known that the present plan of charges is unsatisfactory alike to the operating company and the subscriber.

In the first place the operating company is interested in getting the greatest amount of revenue from the smallest investment and simplest service. At present, in the use and abuse of telephones, the subscriber is the exception and the non-subscriber the rule. It costs the subscriber no more to allow the free use of his telephone by the non-subscriber, and although it is a slight nuisance, the non-subscriber is permitted its free use (clandestinely, perhaps), entailing an expense for extra service on the exchange. To overcome this a changed system of charges must obtain.

The new method will undoubtedly be one by which a first and fixed charge, at a nominal rate, representing a proportioned profit upon the first cost of plant, will be made per telephone. Then an increased charge will be made per additional amount of service required by the subscriber; to illustrate, a flat rate of say $12 per annum per telephone and one cent per call for service. If the subscriber is charged for each call made at his telephone, it will soon become generally known to the public, and the subscriber will be the rule and the non-subscriber the exception, reversing the present order of things. Thus non-subscribers, who take advantage of present conditions, would find it costs as much to use their neighbor's telephone as it would to have one, and the exchange would realize payment for all service rendered.

The new devices for registering the calls made on a telephone are as efficient as a gas or electric meter, and will keep the necessary record, so that there need be no dispute between the exchange and the subscriber when time for settlement comes.

One of the new features of modern telephony will be public toll stations *ad libitum*, where the public may drop in its penny, use the telephone and not annoy private subscribers. It may not be too much to assert that within a very short period such toll stations will be found to pay in nearly every block in the central portions, and every few blocks in the outlying districts of the principal cities.

When the non-subscriber is made to furnish his share of the maintenance of a telephone system, it is easy to see that the rentals alone will be reduced one half or more. It will also extend and increase the number of telephones without so greatly increasing the maximum amount of service. Further, it would bring the subscriber within the range of quick service, which is an important element. For instance, if John Smith has a telephone, his next door neighbor, Thomas Brown, makes use of it. When some subscriber in the system desires Brown, he calls Smith, and te time absorbed in sending for Brown is unnecessarily wasted and calls upon the line are responded to by the reply "busy." The nuisance of "busy" telephones is too well known to need elaboration here.

Now that magneto and non-infringing telephones are a decided success, the features I have pointed out, together with many others which will make themselves prominent in the near future, will occupy the earnest attention of telephone men, and will result in material changes for the better of telephone practice.

The Western Electric Railway Company Enters the Railway Field.

The growth of the electric railway in this country during the past two or three years has been so rapid and extensive that it may justly be considered the most important part of the electrical field to-day. The latest comer in this promising field is the Western Electric Co., of New York and Chicago, which has decided to enter the railway supply trade and to carry in stock a full line of everything necessary both in the construction and operation of electric railways. The company will carry a large variety of types of railway material, among which may be mentioned the standard cap and cone and West End types of overhead material, of a high grade of insulation and made of the very best gun metal. The company will also handle everything necessary for overhead equipment, as well as tools, wire, car and station fittings, testing instruments, etc., so as to be able to fill any order for railway work. In addition to this the company will carry a line of repair parts of motors, controllers, etc., and will rewind armatures and refill commutators. In fact it intends to supply a railway construction company or a railway in operation with anything in the railway and supply line.

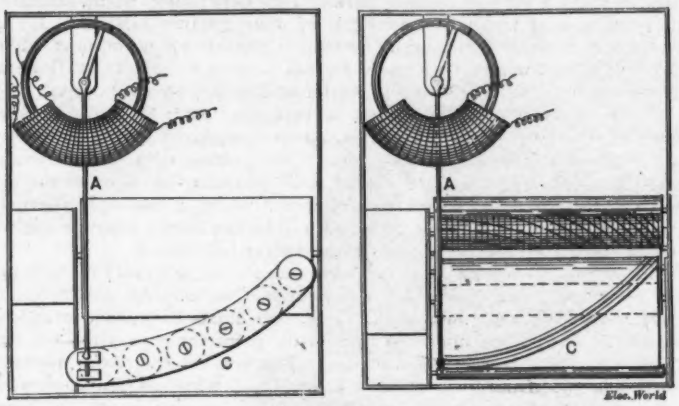
The Western Electric Co. is also bringing out a line of overhead material which is a modification of the West End type, retaining, it is claimed, all the good points of the West End hanger while at the same time it is much lighter, more symmetrical and more economical. A section insulator and insulated cross-over are also among the new goods that the company has in preparation. The facilities of the Western Electric Co. for handling electrical goods of all descriptions is well known and its reputation in the electrical field is so firmly established that it will enter upon railway work with every assurance of success.

Recording Meter.

The question of measuring and recording an electric current flowing in a circuit has long been appreciated as one of the most interesting and important problems in the electrical field. The approximate and summary results heretofore obtainable cannot be satisfactory to all interested parties, for it is not enough that a consumer of electric current be told that during a certain period he has received so many watts or amperes hours; he wants a first proof of the correctness of such a statement, and further, he wants to know under what conditions he has received the current, so as to enable him to judge what use he has had from the same. The electro-metallurgist, for instance, if he needs 100 amperes at 2-volt tension cannot be satisfied if he receives 2 amperes at 100 volt tension, nor can a consumer of electric light be satisfied with 60 volts when he needs 120, yet any such consumer has up to the present been obliged to pay for all energy whether it was useful to him or not. It is thus evident that the only satisfactory instrument for measuring electricity, must be the one which not only gives a lasting, permanent record of the amount of current that has passed through a circuit per unit of time, but also indicates under what conditions said current passed.

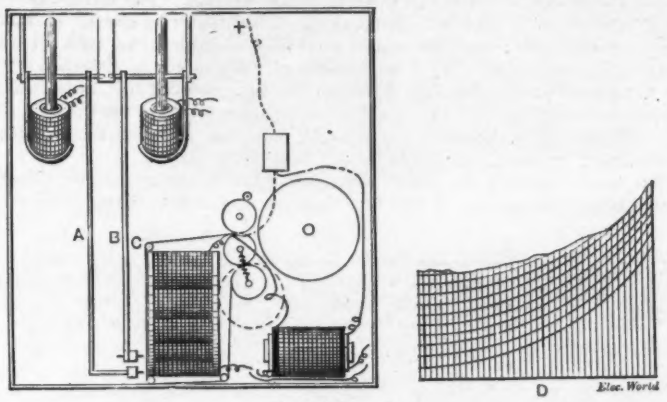
A patent has been recently granted to Mr. J. W. Th. Olan for an instrument of this kind, of which we give an illustration. It consists principally, as shown in Figs. 1, 2, 3 and 4, of a record sheet D, moved by a time mechanism, which, as it passes the support plate, C' is marked upon

by the two pointers, D and D′ these pointers, which are moving in correlative arcs over said plate and sheets, are governed respectively by variations of the tension and quantity of the current, and in this way a continuous, permanent and correlative record is made of the tension, as well as the quantity of the current for a certain period of time. The



FIGS. 1 AND 2.

sheets may afterwards be used as an undeniable and corroborating evidence for justly regulating the accounts between the supply companies and the consumer. The Swedish-American Engineering & Art Co.,



FIGS. 3 AND 4.

a concern formed for carrying on general engineering business and promoting inventions, has secured the control of the Olan Recorder

Standard Trolley and Trolley Wheel.

The trolley and wheel shown in the accompanying illustration have recently been placed on the market by J. H. Bunnell & Co., 76 Cortlandt Street, New York City. The trolley has few parts, is simple, light and strong. A positive contact is secured at any angle from a horizontal position to perpendicular, which renders the trolley of special value for use in car barns and under bridges and other places where the trolley

BUNNELL TROLLEY.

wire is often unusually low. It has quick action, preventing its jumping from the wire at frogs, crossings, etc.

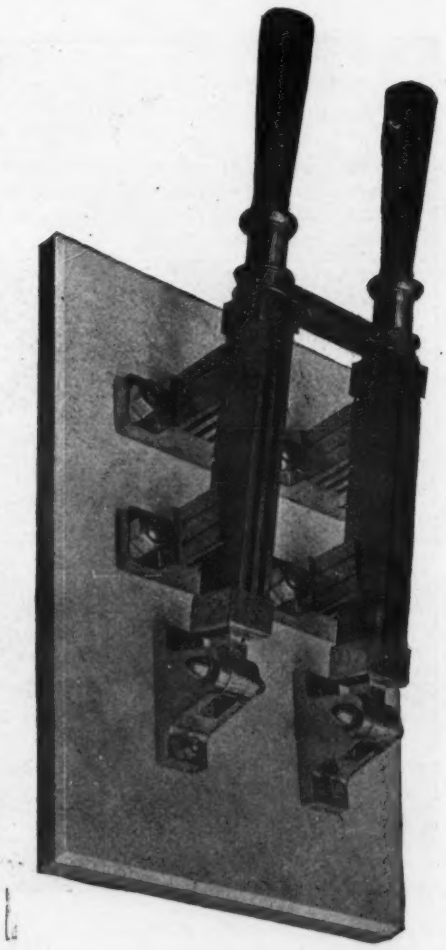
The wheel is made of the highest grade bronze, and is very durable. Special care is taken in its composition to insure long life and yet relieve

BUNNELL TROLLEY WHEEL.

the trolley wire from all unnecessary wear and tear. It is made in the best form for wear and has a high conductivity. It is fitted with the best quality of graphite bushing, and is adapted to the standard trolley fork.

Large Capacity Switch.

The accompanying illustration shows a new style of switch for work requiring a large carrying capacity, which has been recently introduced by J. Grant High & Co., 123 North Third street, Philadelphia. A novel feature of this switch is the construction of the blades and jaws. The former, as will be noted in the illustration, are made up of sections,

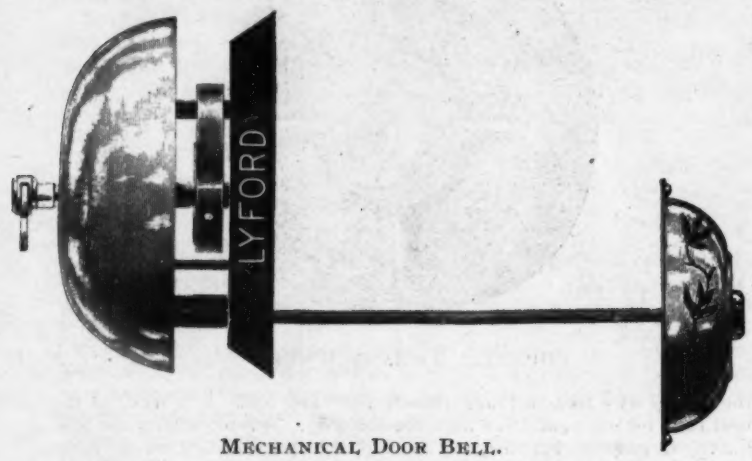


LARGE CAPACITY SWITCH.

thus allowing means of perfect contact and ventilation, and at the same time avoiding the usual bulky appearance of switches of the same carrying capacity. The jaws are specially designed to form a perfect contact by being made in sections longitudinally and divided transversely. This style of switch is made in sizes ranging from 700 to 10,000 amperes

Mechanically Operated Bells.

In the type of bell illustrated herewith, invented by N. J. Busby, 8 Bedford street, Boston, the advantages claimed are that there is no breaking of circuits or grounding of wires or bother with batteries in any way. They are more sensitive to touch than electrical bells and are always safe and reliable, and when once in place all expense ceases.

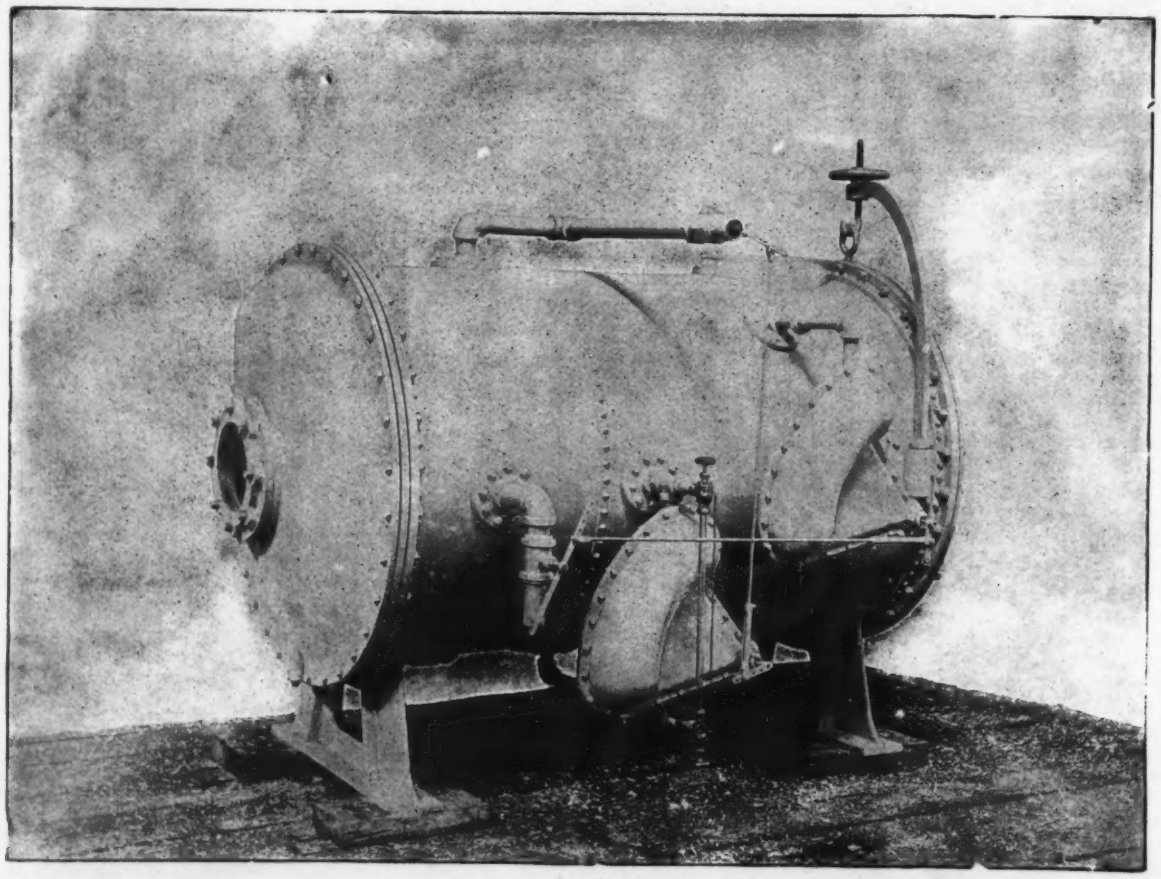


Mechanical Door Bell.

They give the long electrical ring and are worked with either a push button or a pull knob, and are applied on the centre or side casing of a door or at any required distance away. They are also worked from the floor by a foot push under the table, or where most desirable to locate such a push to call servants from any part of a house.

Heater, Purifier and Receiver.

The apparatus illustrated has been expressly designed by the Stillwell-Bierce and Smith-Vaile Co., Dayton, O., to meet the requirements of architects and engineers, in connection with the steam-heating of large buildings. By its means cylinder oil is removed from the exhaust steam before it enters the feed water heater. There is a large area of removable shelves, which serves the double purpose of heating the feed-water and depositing the scale-producing salts; there is also a very large space for holding heated-feed water and returns, which are both absolutely and automatically controlled.



Heater, Purifier and Receiver.

Electricity in Mining.

An interesting installation has recently been made by the General Electric Co. in a silver mine in the South, in which electrical apparatus plays a very important part. The generating plant, situated at the mouth of the mine, consists of two engines 10½ and 16x12. These are connected through friction clutches to a common shaft carrying a band wheel, and each engine operates one D-62 General Electric generator of 500 volts potential and 85 horse-power output.

The power-house also contains a separate "9x9" McIntosh & Seymour high pressure engine, operating an arc dynamo of 18 lights capacity and a 150-light incandescent dynamo. The pulley upon the common shaft is to be used to operate a third D-62 generator as soon as the extensions in the mine warrant the addition, while a 500-light alternating plant, which is also to be installed, will be run from a separate engine and will supply light for a town about two miles distant.

The current is carried from the power-house to the tunnel of the mine and the various shafts over insulated copper wires. At shaft No. 1, 1,000 yards from the mouth of the mine, two hoists have been installed, one of the single type operated by a 16 h. p. motor, the other of the double reel type, a description of which is given below. At a distance of about a mile from the station is shaft No. 3, which is equipped with a 25 h. p. single drum hoist. Shaft No. 1 still retains its steam hoist and is provided with a small direct connected plant of the marine type.

The large electric double reel flat rope hoist is probably the largest ever made, and has just been completed by the General Electric Co. It nominally works in balance and has a capacity on each side of 5,000 pounds, the mean speed of the rope being 500 feet per minute. The motive power is furnished by a General Electric 125 h. p. motor of the L. W. P.-20 type, similar in size to the large ones used to propel the cars of the Intramural Railway. The lower frame of this motor is provided with feet, which allow of it being bolted to the bed plate of the hoist. The maximum demand on the motor will be about 80 h. p. when the hoist is working singly. Under normal conditions, that is, when it is hoisting in balance, the demand will be about 50 h. p.

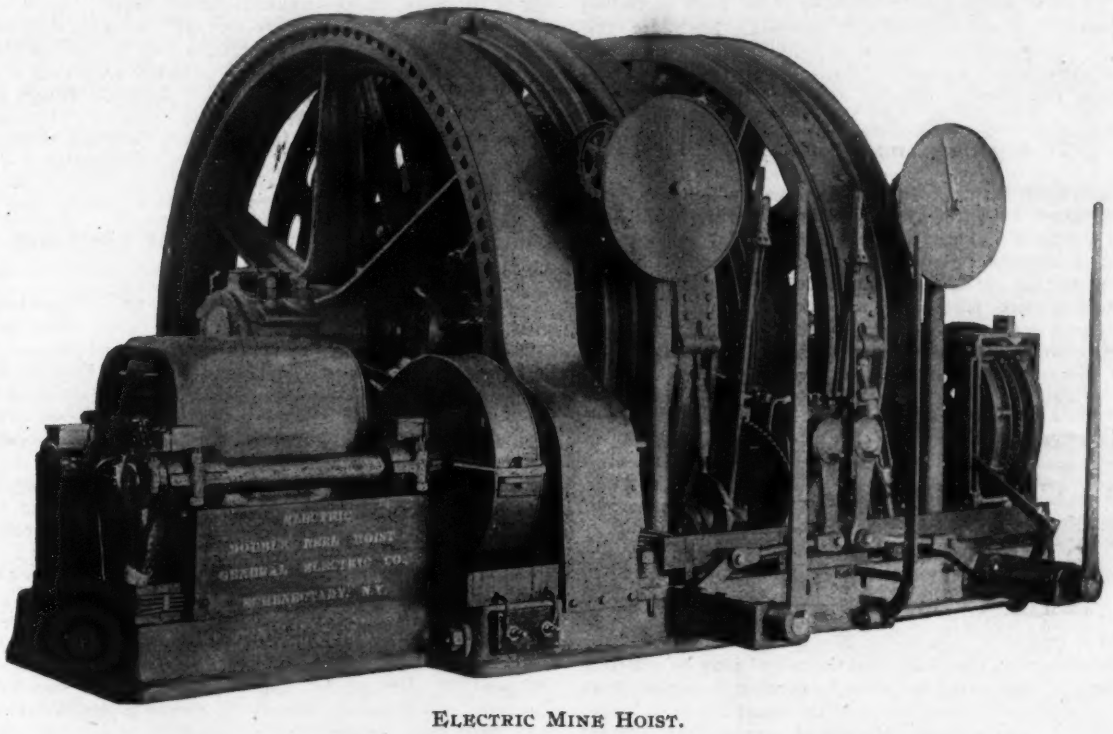
The hoist itself is extremely compact; the dimension of the base, exclusive of the motor, is 9¼ feet square, the width being increased by about 3 feet 4 inches by the addition of the motor. The height is about 7¼ feet above the foundations, the reels, however, extending a little below the level of the bed plate. The reel centres are 4 feet apart, and have a capacity each of 1,000 feet of flat rope. The diameter of the naked reel is 3 feet; this, when wound with the rope, is increased to eight feet. On account of the direct relation between the working diameter of the reel and the weight of the rope unwound, which forms a consider-

able part of the load, the work done by the motor remains practically constant.

When the load is started from the bottom of the mine, the weight of the rope, about 2,500 pounds, is added, but it is being wound on an 18-inch radius. When the load nears the top only the ore and the skip are being lifted and the winding radius has increased to 48 inches. The average speed of the intermediate shaft is 200 revolutions per minute, which gives a starting speed at the bottom of the mine of 400 feet per minute and at the top 600 feet. The regulation is therefore automatic.

The entire weight lifted from the bottom is about 5,500 pounds—2,000 pounds of ore, 1,000 pounds of skip and 2,500 pounds of rope. The reels are loose on the shaft, the hubs having brass bushings which may be readily renewed when worn. To each reel is cast on the side a polished clutch ring 5 feet in diameter, and upon this is fitted a Webster, Camp & Lane band friction clutch, the ring being keyed upon the shaft. This clutch is of improved type, and forms one of the special features of this hoist. By its means the load may be started at any point without jerking; or the load may be released and allowed to come to rest when the hoist is running at full speed. The clutch has wooden faces which can easily be replaced when worn.

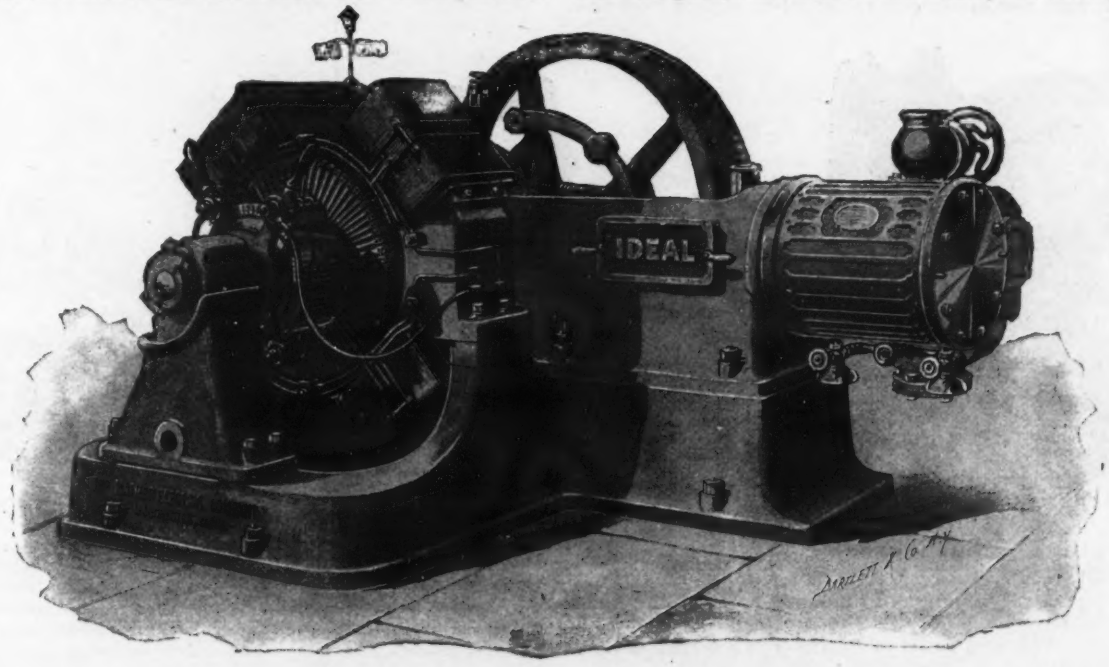
The brake rings are keyed to the reel and are 7 feet 6 inches in diameter, with an 8¼ inch face. Each is designed to allow for expansion of the brake when lowering, which heat may bring about. The reel shaft is of steel 6 inches in diameter, the journals being increased to 8 inches at the centre, and run in bearings babbitted and adjustable. The indicators on the front show the position of the cages. The weight of the hoist complete is about 3,200 pounds, and no part is so large but that it can be lowered into a mine, the tunnel of which is 7 feet by 8 feet.



ELECTRIC MINE HOIST.

Direct-Connected Generators.

Direct-connected generators for electric lighting and power plants have come into general use, both in this country and abroad, and are conceded by the leading electrical engineers and architects as being the most efficient in both theory and actual use. Briefly, the advantages of the direct-connected apparatus are: First, economy in floor space, this advantage being especially appreciated where the generator is in crowded or limited quarters; second, the absence of noise in the operation of the plant, whic follows from the absence of all belting, etc.; third, economy in operation over a belt plant, which is considerable at all times, but especialy so where the load is of an intermittent nature or where the plant is not operatin at its full capacity at all times; fourth, extreme sim-



DIRECT-CONNECTED MULTIPOLAR GENERATOR.

plicity and minimum requirement of attention, and long life of apparatus on account of slow speed in operation.

The illustration herewith shows a 100 kw. Mather multipolar generator, of which type a description appeared in our issue of August 11, direct coupled to a 150 h. p. Ideal engine. These generators, which are manufactured by the Mather Electric Co., Manchester, Conn., are designed to be directly connected to any first-class type of engine adapted for this work, and are exceedingly compact. They are self oiling, self-exciting, self-regulating, and, after being started, require no attention. They are compound wound and entirely self-regulating, and equally well adapted for electric lighting, electric railway, or power purposes.

Trolley Harp and Wheel.

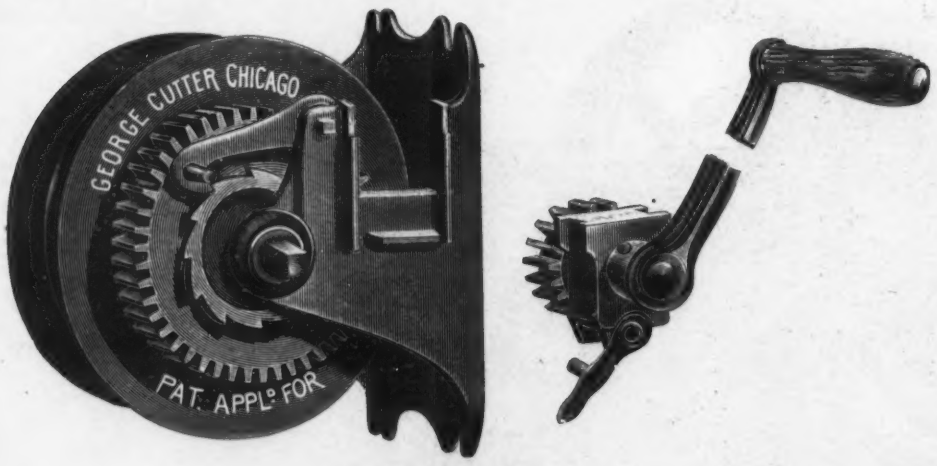
We illustrate herewith a trolley harp and wheel which has been recently put on the market by the Hubley Manufacturing Co., Lancaster, Pa., which has been designed after the most careful study of the conditions which this important element of the car equipment has to meet. The crescent section of the side bars adds strength to lightness, and affords a rounded surface which will not catch or dent the trolley wire. They are shaped to give ample room or the edges of the wheel and perfect protection to the contact springs. The pin is fastened by an improved method, giving a large bearing and avoiding sharp corners.

Trolley Harp and Wheel.

The metal is so distributed in the body that the wheel may be entirely worn out, while the wire can never be worn by coming in contact with the harp, which is one of the greatest faults of the usual forms of harps. The wheel is designed to give a greater amount of service than any yet produced, which result is obtained by using the highest grade of bearing bronze, and in the proper distribution of the metal. Many of these wheels are still in service after making the phenomenal record of 10,000 miles.

Combination Windlass.

The geared windlasses familiar to arc lamp users have two disadvantages, one being the high cost, due largely to the fitting of the pinion and gear, the other the loss of time in lowering lamps, as the gearing is generally needed only for the raising. George Cutter, of the "Rookery," Chicago, in bringing out the new form of windlass shown in the illustrations, has kept these points in view. This is called a combination windlass, because it can be used either as a plain or as a geared device, at the trimmer's discretion.

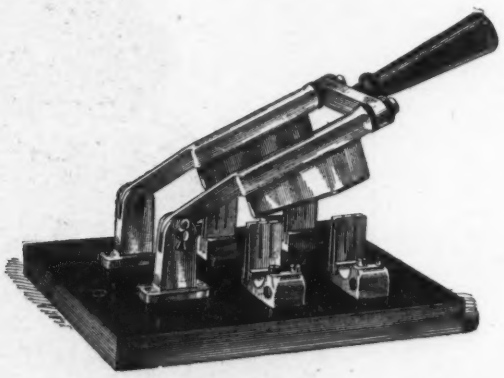


Arc Light Hoist.

The windlass proper has a strong frame, with the back curved to fit the pole, the slots for the supporting bolts being so planned that the device can be quickly put up. The handle shown in the cut is rigidly secured to a small pinion mounted in a light bearing, which is so shaped as to fit into a recess in the windlass frame. By slipping this into place and locking it with the hinged cam, the pinion is brought into gear with the hoisting drum, thus giving three times the ordinary leverage. The pinion-handle with these fittings is still quite light so as to be easily carried by the trimmer, and as only one of these is needed for several dozen windlasses, there is quite a saving over the cost of windlasses with fixed gears. The details are carefully worked out and the whole looks like a very practical device.

A New Knife Switch.

The accompanying illustration shows a double pole, double break switch recently placed on the market by Taylor & Clark, 510 Arch street, Philadelphia, Pa. It is simple in construction, strong and durable, quick in action, and of unusually neat finish. All the contact blades are sweated in and riveted and carefully finished, so that good contact is insured. The insulation is carefully rounded off, and the workmanship throughout the switch is of such a standard as to give it a very attractive appearance. The screws upon which the knife swings are tapped only on the end so that a smooth rotation surface is secured. In all sizes above 60 amperes a quick break device is used. These switches are made in all styles and sizes, from 15 to 1,000 ampers.



The "T & C" Knife Switch.

A New Incandescent Arc Lamp.

The arc lamp we illustrate, made by the Manhattan General Construction Company, 50 Broadway, New York, contains a number of new features and is claimed to present the advantages of fewness of working parts, economy in trimming and carbons, an enclosing globe acting as a spark arrester and preventing insects from collecting within, susceptibility to artistic designs, regularity in feed, a positive cutting out action, and capable of burning singly with economy on incandescent circuits.

To embody these features in one lamp, a radical departure from prevailing types was necessary, and an inspection of the general appearance and detail of construction will show a bold handling of the problem.

Only one form of construction satisfied all requirements, and that was to have the mechanism concentric to the central stem; magnet, armature, clutch mechanism, cut-out, carbon-holding frame and globes. In outside lamps the main-line circuit runs through a switch in the cap and the lamp may be removed and the circuit left to pass uninterrupted. The wires enter the cap through inclined insulated openings which exclude the weather. To shorten the lamp, the customary carbon rod has been dispensed with and a thin sheath or holder feeding through the clutch rings with the bare carbons substituted. A cushioned clutch feed is provided, which gives a smooth and imperceptible feed, without the characteristic jumps of arc lamps.

The most important feature of the lamp is the enclosed globes. The outer globe is air tight at all points except at the bottom, where there is a hand-hole large enough to permit of cleaning and trimming the lamp, which is yieldingly closed by a detachable dust-pan. This prevents the oxidation of carbons, and makes it practical to trim the lamp without disturbing any air-tight bearings. The upper opening of the outer globe is secured to the carbon frame and there made air-tight by asbestos gaskets, the globe and frame screwing into the body of the lamp.

Within this enclosing globe and immediately surrounding the arc, is a smaller globe into which the carbons are fed, there being, however, no air-tight bearings. The outer globe is a storage for the products of combustion, or diluting chamber, thus preventing access of air containing oxygen to the carbon points. On the formation of an arc the enclosed air is heated, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to carbon monoxide, and this, with the remaining nitrogen, surrounds the arc and protects the points from further combustion.

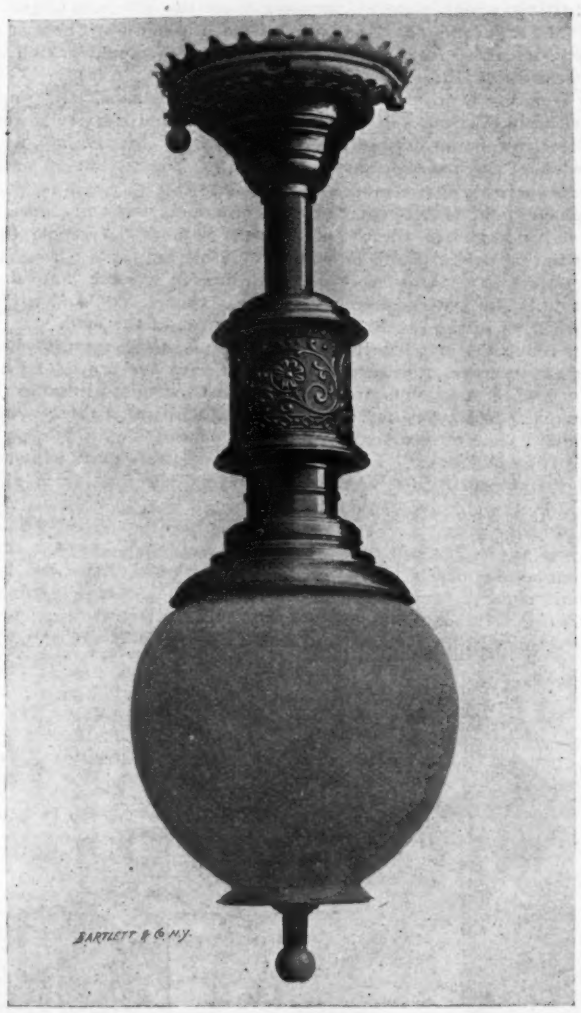
By this system of burning of carbons in enclosed chambers, half-inch carbons will burn eighty hours without retrimming, and without

any blackening or discoloration of the globe. Owing to the high potential at which it is possible to burn the arc in the enclosing chamber, the efficiency of the lamp is greatly increased.

The lower part of carbon frame is in the shape of a ring having a diametrical enlargement to admit the arms of a spider-shaped casting, and which is provided with an adjustable movement on the carbon holder. This carbon holder has a porcelain handle and a spring to hold the yielding pan tightly against the lower opening of the globe. A longitudinal bore in the carbon holder admits the negative carbon, the upper part of the bore being enlarged to form a seat for the small globe. A metal cover, through which the positive carbon loosely feeds, is placed over the mouth of the small globe and acts as a cut-out when the carbon has been burned to a predetermined point.

For inside lamps a rheostat of enameled iron is provided in the shape of a head-board with binding posts, hanging straps and switch complete. An opening in the centre of the rheostat permits of securing it to the ceiling by half-inch lag screws. Porcelain insulators, placed over four studs provided for that purpose, may be used to separate the rheostat from contact with the ceiling. When not desirable to secure the rheostat directly to a ceiling, the lamp may be suspended from a ring.

As carbons are only consumed at about the rate of one inch in eight



NEW TYPE OF ARC LAMP.

hours, it will be seen that the lamp seldom feeds, so that, aside from the feature of the sneak feed provided in the lamp, carbons are only required to change positions about one-tenth as often as in a lamp which burns in the open air, and are, consequently, much more steady and regular in burning.

The Johnston Rail Bond.

The value of a good return circuit in electric railway work is now becoming to be recognized as a necessity, not only to obviate the injurious effects of electrolysis on neighboring pipes, but also as a matter of economy. That the former is now a real danger is acknowledged by many who fomerly regarded the matter as one of relative unimportance, and the more recent literature on the subject shows that with time the most serious damage may be done. As a consequence, if the matter of providing a proper return, which in most cases may be secured by good bonding, is not attended to by street railway companies, they will sooner or later meet with interference from municipal authorities which will be far from agreeable.

From a direct economic standpoint the matter is of even greater importance. A resistance through imperfect bonding of a tenth of an ohm on a ten-car line may amount to a loss of energy as high as 13 horse-power, and as deterioration will be constant, rebonding at greatly increased cost will finally be required.

The rail bond which we illustrate, manufactured by the Car Equipment Co., 741 Drexel Building Philadelphia, is claimed to obviate all trouble from defective and insufficient bonding, and is the result of seven years' experience and experimenting on the part of the inventor., Mr. A. Langstaff Johnson. Owing to the contact afforded by the hole in the web of the rail, and also the side of the rail against which the bond nuts are jammed or drawn up, the area of contact is twelve times the area of the wire, thus enabling the maximum conductive capacity of the track to be utilized. This bond being thus much superior to rivets, channel pins or any other bond now in use, a track can be laid with

FIG. 2.—JOHNSTON RAIL BOND.

the assurance that it need never be disturbed to inspect the bonds, for the contact afforded is durable, being almost indestructible. The size of the wire with this bond can be varied and thus, for instance, as the power-house is approached where the flow of current is heaviest, the bond-wire may be increased to any size in order to provide for the accumulation of current on that part of the line; this can be done without altering the bond-nut at all, but merly by tapping it sufficiently to take the size of the wire desired.

The bond is secured to the rail by means of two nuts, shown in Fig. 1, which are applied to the ends of the bond, as shown in Fig. 2. The

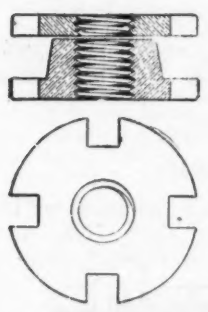


FIG. 1.—NUTS OF BOND.

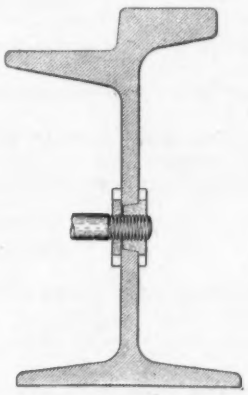


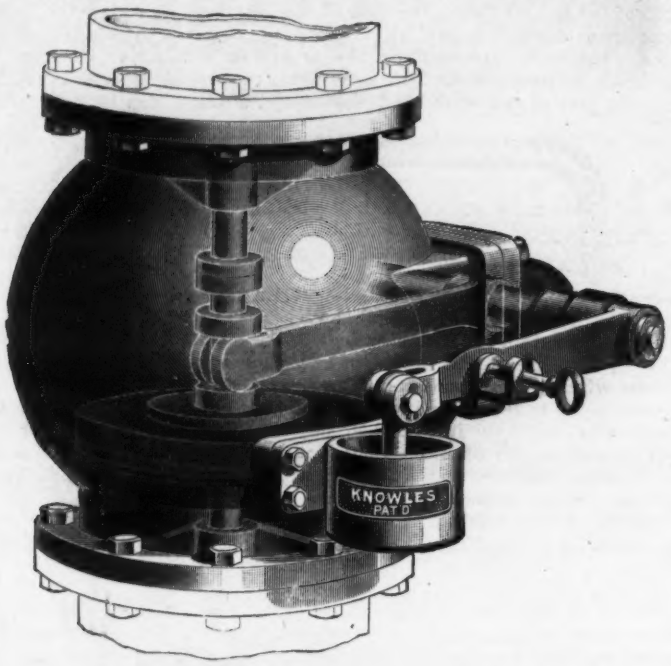
FIG. 3.—THE BOND APPLIED.

web of the rail is perforated by a taper hole, and after the insertion of the bond the nuts are screwed up tight, forcing the tapered nut into the nut, as shown in Fig. 3. In order to make the contact as perfect as possible, the rail is faced on each side immediately surrounding the hole in the web where the bond nuts come in contact with it, for which purpose a special tool has been designed, which enables this work to be done accurately and expeditiously. The hole in the web of the rail is punched in the usual way and then bevelled by a counter borer, which is furnished for the purpose.

Automatic Exhaust Relief Valve.

The accompanying illustration of the Knowles automatic relief valve, manufactured by the Knowles Steam Pump Works, 93 Liberty street, New York, shows this valve to such good advantage that a minute description of it is hardly necessary. The valve is for use on the exhaust pipe of condensing engines, especially those whose stoppage or even slowing up would entail serious consequenecs, such as engines for electric power and lighting purposes. The valve, which stands in a vertical position, opens automatically in case of any accident to the air pump, or a lack of injection water that would cause a loss of vacuum in the condenser. The valve proper is made of a material that will withstand the heat of the steam, and is made to fit air tight upon a composition seat. The vertical motion of the valve is limited by a collar on the spindle, the latter being guided above and below the valve. One of the principal features of this valve is the dash pot, which is shown bolted to the side of the chamber. The dash pot cylinder contains a piston connected by levers to the main valve, and moves simultaneously with it. As it is necessary for the valve to open promptly, air is admitted under the piston dash pot through a small valve, opening inwards, placed in the bottom of the cylinder. This allows of a quick upward motion, giving instant relief to the accumulated pressure in the exhaust pipe, and allowing the engine to run non-condensing. As soon as the vacuum in the condenser is again

obtained, the atmospheric pressure tends to seat the valve. By this action the air under the dash pot piston is compressed, closing the small inlet valve, and slowly escapes between the cylinder and piston and allows the main valve to noiselessly seat itself without shock or jar. When the engine is to be run non-condensing, a special arrangement is



Automatic Exhaust Relief Valve.

applied, as shown, to hold the valve open and allow the exhaust steam to pass directly into the atmosphere. These valves are made in various sizes to suit different requirements.

Electric Door Opener.

The electric door opener we illustrate, now being placed on the market by J. Jones & Son, 67 Cortlandt street, New York, will, it is claimed, require only a small battery power to operate it, even against an unusual pressure. The mechanism is simple and efficient, the locking device consisting of a specially shaped pivoted part controlled by a bent spring, and the movement of the magnet armature to release this part being very small. The finish and workmanship are of the best quality.

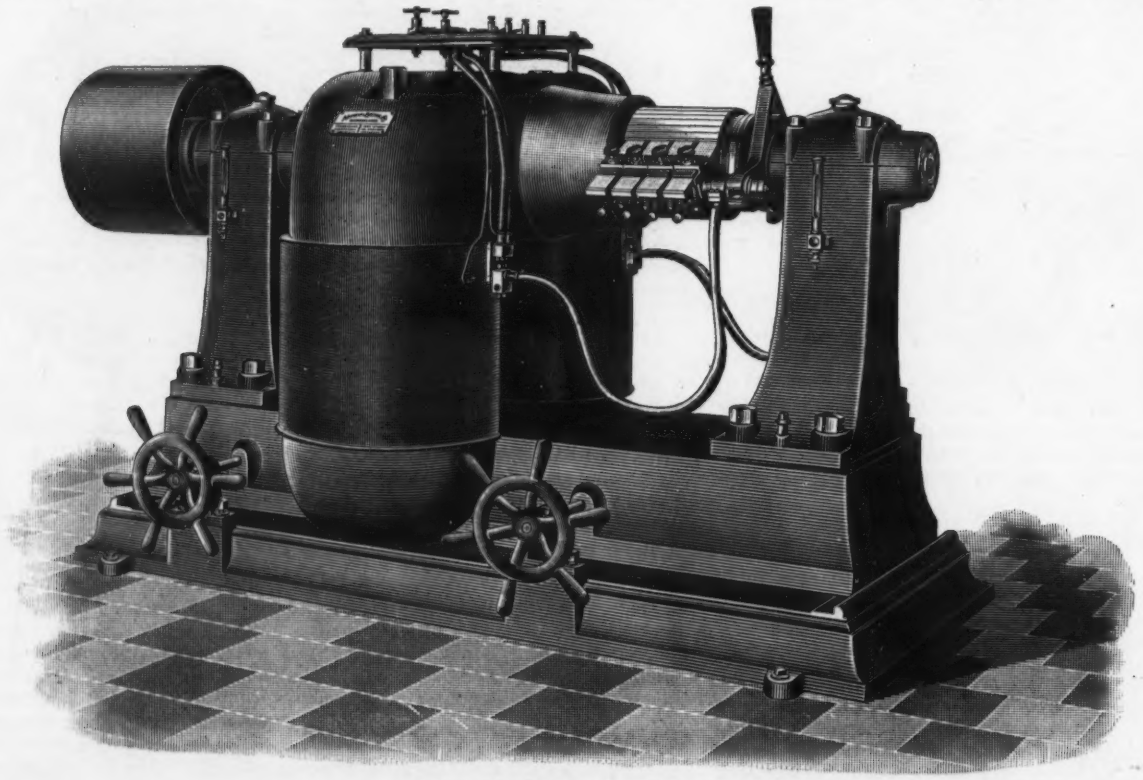
New National Dynamo.

The over-type bi-polar dynamo was originally adopted as a standard at the National Factory, Eau Claire, Wis., and the experience of several years has confirmed the opinion that for all capacities up to as high as sixty kilowatts it is unrivalled as a commercially successful type. This form has therefore been adhered to when the new National Electric Company undertook the design of a complete new line of dynamos and motors, and we illustrate the 50 kw. machine.

Referring first to the purely mechanical features, it will be observed that the machine is compact and substantial looking, with regular outlines. It is mounted upon a heavy cast-iron base, and is provided with convenient and easily operated shifting screws for tightening the driving belt. The base and bearing supports are made of liberal proportions, so as to be entirely unyielding. The bearings of the machine are of the ring, self-oiling type, and are self-aligning; the bearing sleeve is provided with a spherical surface which rests in a seat of corresponding form in the pedestal, constituting thereby a ball and socket combination, which makes it impossible for the bearings to get out of line. The armature shaft, of ample size to secure stiffness as well as strength, is turned from a high grade of forged steel, which insures good wearing qualities.

The armature is adjusted to perfect rotative balance, and runs free from straining actions. It is also balanced magnetically in a longitudinal direction, being held in the proper position by the action of the field without the use of collars on the shaft. The action is similar to that of a spring which allows a slight elastic end-play, yet resists undue displacement. The field magnet has rounded, easy outlines and is massive in form. By the use of a powerful field, by giving the pole pieces the proper form and bore by providing ample brush surface, the most satisfactory results have been obtained in smooth and sparkless operation. The machines will take care of themselves, and will not require shifting of the brushes for each variation of the load.

By massing the metal uniformly in the magnetic circuit by using wrought-iron cores, and carefully determining the proper field windings, a field of maximum strength is obtained with a minimum of exciting current. The efficiency is further promoted by properly constructing the armature core and arranging the winding with a view to reducing armature losses. Durability of the machine parts is assured by the thoroughness of the construction and long life for the insulation is secured by the absence of that high degree of heat incident to the operation of many dynamos. The armature is of the standard drum type. The cores are built up of thin steel disks, insulated, keyed to the shaft, and clamped rigidly in position. There are no less than five layers of selected insulating materials—including oil-paper, linen, ducking, mica, etc.—between the core and conductors. The entire winding is stayed and wedged with fibre strips, and it is firmly banded at intervals not greater than an inch and a quarter along its length, each band being composed of several wraps of phosphor bronze spring wire soldered together; thus, the winding constitutes a solid unyielding mass. All parts of the machine are made to standard guages and templates, and are interchangeable.



New National Dynamo.

Door Opener.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 25, 1894.

GENERAL ELECTRIC has, as always in times of activity, been the foremost of the electrical stocks. It has at various times during the financial week, occupied a conspicuous position in the stock market dealings, the trading in it being marked by a sincerity that evidenced the presence of genuine buying orders. It has been very strong. The buying has emenated from the best inside sources, from people who have become acquainted with the company's uninterrupted progress towards complete rehabilitation. Work on the equipment contracted for by the Chicago elevated railroads is being pushed well along. The company is also paying particular attention to the designing and construction of suburban railway motors of a heavier pattern than those now in use on the more extended lines in the city limits. There is also now in experimental use at Schenectady a 110-ton electric locomotive built for the Baltimore & Ohio Railroad Company, and soon to be used by them in their new terminals at Baltimore. Some 3,000 men are now employed at Schenectady and about 2,000 operatives are at work in the Lynn shops, where none but the light work is now being done. At present the company has orders in the railway department alone for 61 generators and 8 of these are ponderous machines.

FORT WAYNE ELECTRIC matters continue to engross attention. President McDonald avers that the present business policy is a complete success, but declines to declare himself relative to the announcement that the General Electric is infringing on railway patents secured by the Ft. Wayne Electric corporation in this week's purchase of the Wenstrom Electric Company of Baltimore, capital $1,000,000. The corporation invites subscriptions from the old stockholders for its 6 per cent. gold debenture bonds at 90 per cent., and interest. According to the official circular, subscribers are to pay 10 per cent. of the amount in cash at the time of subscription to the American Loan and Trust Company, 40 per cent. in cash in 30 days thereafter and at the same time the remaining 50 per cent. of their subscription in trust receipts for stock of the Ft. Wayne Electric Company's stock now deposited with State Street Safe and Deposit Company at $5 per share. This is in accordance with the reconstruction program recently promulgated.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES continues in its policy of retiring the preferred stock. This week it set aside $65,000 for this purpose, and secured from the many offerings made 658 shares, paying therefor an average price of $98.65 per share. This makes a total of 14,682 shares cancelled since the "trust" was formed last year, all the money being derived from dividends and interest payments on the stocks and bonds incorporated, or rather deposited in it. Besides this week's purchase of shares, the trustees have set aside another $66,000 to buy in preferred shares, proposals to be received until August 30. There are only 45,000 shares preferred stock altogether; deduct 14,682 already retired from the total issue, and there are left outstanding 30,318 shares. As they have been retired at an average rate of 2,000 shares a month since there has been any accumulation of profits it will only take fifteen months before the whole issue is retired, which will make the $4,500,000 common stock the sole owners of the $12,000,000 stocks and bonds acquired from the General Electric last year for $4,250,000.

BELL TELEPHONE matters promise some interesting developments at an early date. President Hudson is expected home from Europe on the 14th of next month, and some determination of the company' financial policy relative to the issue of the $30,000,000 new capital stock authorized by the Massachusetts legislature will then be decided upon. This new stock, according to legislative restrictions, must be sold at public auction, but the company's officials do not yet know how much is to be issued at a time, nor whether they will agree at all to the present restrictions. There is still talk heard of a removal of offices to this state, and of getting the New York legislature to give permission to issue the new stock at par.

WESTERN UNION TELEGRAPH stock continues to hold its quotation at 89 to 89⅛ with great steadiness, reflecting merely the general strength of the stock market, as there has been at no time during the past week any decided movement in either direction. Bull points in great profusion are, however, being distributed on the Stock Exchange, and predictions are freely made that the stock will sell at 95 or upwards in the near future. Present earnings are understood to be on a basis that assures a continuation of present dividends, August business being declared to be nearly 20 per cent. ahead of that done in July. There is, moreover, a large short interest extant, and, if this should once be scared into an attempt to cover, some lively scrambling to buy will be witnessed, as the supply of floating stock is not very large.

WESTINGHOUSE ELECTRIC continues quiet. The company is bending all its energies toward getting into the new works at Brinton, near Pittsburg, and the officials have all they can do to attend to strictly business matters, letting Stock Exchange quotations take care of themselves. Quotations, however, continue well held.

EDISON ELECTRIC ILLUMINATING OF NEW YORK. The company's returns so far for August indicate that the net earnings this month will show the same ratio of increase that has been made in previous months. New York Stock Exchange statistics show that the illuminating company's net earnings have increased 300 per cent. in six years. The net earnings for 1894 are now estimated to be easily $750,000.

INTERIOR CONDUIT AND INSULATION COMPANY report to be now steadily earning 8 per cent. The company's record shows an increase in net earnings of 1892 over 1891 of 33 per cent., the same rate of increase for 1893, while the first six months of 1894 shows an increase of 25 per cent. The stock is almost entirely held by the officials of the company.

AMERICAN DISTRICT TELEGRAPH COMPANY. It is now thought that when the directors meet early in September a quarterly dividend of 1 per cent. will be paid. This company is rather unsteady in its dividend rates. Last year it paid 3 per cent. per annum.

THE NIAGARA FALLS POWER COMPANY has increased its capital stock from $2,600,000 to $3,000,000. At the meeting Secretary Rankine of the Cataract Construction Company, represented the New York interests and the vote was favorable to the increase, at the rate of 40,000 shares at a par value of $10 a share.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
*Edison Electric Ill., New York	100	98⅛	100
* " " " Brooklyn	100	101	103
* " " " Boston	100	120	121
" " " Chicago	100	135	145
* " " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	3	3¼
General Electric	100	42¾	44
Interior Conduit & Ins. Co.	100	45	55
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	33	34
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	1,000	109	110
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	200	201
*American District Telegraph	100	40	45
American Telegraph & Cable	100	89½	90
Central & South American Telegraph	100	105	110
Commercial Cables	100	120	145
*Erie Telephone	—	45¼	46
Gold & Stock Telegraph	100	100	102
*Mexican Telegraph	100	190	200
*New England Telephone	—	68	69
*Western Union Telegraph	100	89⅛	89¼

*Ex. div.

NEW INCORPORATIONS.

THE TROJAN TELEGRAPH COMPANY, Troy, N. Y., capital stock $5,000, has been formed.

THE PONTIAC TELEPHONE COMPANY, Pontiac, Ill., capital stock $3,000, has been incorporated.

THE SEASHORE ELECTRIC LIGHT & POWER COMPANY, Asbury Park, N. J., capital stock $100,000, has been incorporated.

THE AMERICAN FRICTION MOTOR COMPANY, East St. Louis, Ill., capital stock $2,000,000, has been incorporated by W. B. Wolcott and others.

THE TAYLORSVILLE MILLING & MERCANTILE COMPANY, Taylorsville, Ky., capital stock $25,000, has been incorporated by W. P. Beard and others, to establish an electric light plant.

THE MERCANTILE CARBON COMPANY, New York, capital stock $50,000, has been formed to manufacture a new arc lamp. A. C. Seibola, Mt. Vernon; Harry Hoyt and S. M. Comstock, New York, are interested.

THE CITIZENS' ELECTRIC LIGHT AND POWER COMPANY, Pensacola, Fla., capital stock $20,000, has been formed to operate an electric light and power plant. T. E. Welles, S. C. Cobb, C. J. Heinberg, Pensacola, are interested.

THE NEWPORT HEAT AND POWER COMPANY, Newport, Pa., capital stock, $1,000, has been incorporated to supply electricity for light, heat and power purposes. The promoters are J. H. Irwin, W. H. Gautt and H. Beard, all of Newport.

THE VISCOSITY OIL COMPANY, Chicago, Ill., capital stock $10,000, has been formed to manufacture and deal in general steam and electric supplies and lubricating oils and greases. S. A. Johnson, Wm. H. Little and J. H. Poage are the promoters.

THE FACTORYVILLE LIGHT, HEAT AND POWER COMPANY, Factoryville, Pa., capital stock $7,000, has been formed to supply light, heat and power by electricity. C. A. Sisk, W. N. Manchester, S. Reynolds, all of that town, are interested.

THE NICHOLSON LIGHT, HEAT AND POWER COMPANY, Nicholson, Pa., capital stock $7,000, has been incorporated to supply electricity for light, heat and power. The promoters are C. A. Sisk, Factoryville; F. N. Boyle and H. D. Tiffany, of Nicholson, Pa.

THE CAMDEN POWER & LIGHT COMPANY, Camden, Ark., capital stock $10,000, has been formed to purchase, own and operate electric plants and to upply light and motive power to the public. C. L. Vickers, W. K. Ramsey, and J. S. Cumming are the promoters.

THE MONARCH ENGINE-STOP COMPANY, New York, maximum capital stock $250,000, has been formed to manufacture, buy and sell steam, electrical and other machinery, etc. L. W. Sweet and J. Livingston, New York, and C. A. Benton, Riverdale, N. Y., are the promoters.

THE SCOTT ELECTRIC LAMP COMPANY, New York, capital stock $25,000, has been formed to manufacture and sell lamps and other electric apparatus. R. Outcault, New York; B. H. Herbert, Hoboken, N. J., and Palmer Brown, Woonsocket, R. I., are the interested parties.

THE ACME ELECTRIC COMPANY, St. Louis, Mo., capital stock $3,000, has been formed, to manufacture and deal in electrical supplies and apparatus of all kinds and to do a general electrical business. E. T. Goodberlet, J. A. Goodberlet, L. E. Goodberlet, St. Louis, Mo., are interested.

THE CENTRAL BELL TELEPHONE COMPANY OF VENEZUELA, Chicago, Ill., capital stock $400,000, has been formed to construct, own and operate telephones, and to supply electric light and power for various purposes. The promoters are J. K. Myers, A. Amerman and T. J. Fell.

THE ZIEGLER ELECTRIC COMPANY, Boston, Mass., capital stock, $25,000, has been formed to manufacture and sell electrical and mechanical instruments, machinery, and apparatus. A. A. Ziegler, A. Ziegler, J. O. Ziegler, J. L. Gebhardt, Geo. Sauer, 72 Federal street, Boston, Mass., are the organizers.

THE LOCKPORT CITY & OLCOTT ELECTRIC RAILROAD COMPANY, Lockport, N. Y., capital stock $200,000, has been formed to operate an electric

trolley railroad from Lockport to Olcott, a distance of twenty miles. W. T. Holt, W. D. Gaillard, A. G. Funck, J. L. Toon, M. E. Stone, and E. J. Cunningham, New York, are the interested parties.

THE ROBERTSON INSULATED CONDUIT ELECTRIC COMPANY OF CHICAGO, Chicago, Ill., capital stock $1,000,000, has been formed to make and sell inventions, improvements and patents in electric railway appliances and devices, etc., and to equip and operate street, horse and dummy railways in Chicago. J. L. Murphy, S. B. Bracey, H. B. McMillan, B. W. Sherman, W. O. Osgood and C. A. Dye are the incorporators.

Special Correspondence.

New York Notes.

Office of The Electrical World,
253 Broadway, August 25, 1894.

MR. F. C. BATES left for Europe on the Kaiser Wilhelm August 18, to take a position with the Union Elektricitats of Berlin. He goes over there permanently, and will be employed principally on electric railway work. Mr. Bates is well known, having been connected with the Thomson-Houston Company for three years, at Lynn, Mass., where he had practical experience in electric construction. He has recently been connected with the firm of Charles H. Warner, 50 Broadway, and with him was resident engineer for the Brigantine Transit Company, in constructing a railroad at Brigantine Beach.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, August 25, 1894.

MR. A. B FIELD, for a long time connection with the Thomson-Houston and later with the General Electric Company, being one of their most energetic salesman at the present time, traveling for them in the Eastern States, will on Sept, 1 identify himself with the Iona Manufacturing Company, and will be pleased to see all his old friends at 336 Congress St-, Boston.

THE ELECTRIC APPLIANCE COMPANY, of Providence, R. I., has just completed and has ready for the market a very elegant and extensive line of ornamental flush plate pushes and gas lighting keys. The patterns are elaborate designs in filigree and scrolls, standing in relief, finished in antique copper and brass and modern etruscan, bronze, etc. The Company is doing a driving business filling sample orders for their goods, and promises the trade several other new and agreeable surprises in the very near future..

W. H. BOWDLEAR & COMPANY, 36 Central Wharf Boston, is one among the oldest firms engaged in the manufacture of material for insulating purposes, although because of its extreme conservatism it may not be as generally known as some of its competitors. Notwithstanding this fact, however, it does an excellent business with the electrical trade. "Ozokerite," one of its insulating specialties, is attracting considerable favor. Its strong qualities are pliability, waterproof, moisture proof and odorless properties.

THE IONA MANUFACTURING COMPANY, of Boston, has been kept busy straight along, notwithstanding the summer months and business depression, and in order to meet the constantly increasing demand for its specialties in the line of sockets, switches, cut-outs, etc., additional floor space in its factory has been leased. Mr. Norman Marshall, manager of the company, who believes thoroughly in hard work, and he has been most active in pushing its business, anticipates a considerably larger business this fall than ever heretofore.

THE HANDBOOK entitled "Standard Wiring," for electric light and power, by H. C. Cushing, Jr., electrical inspector for the Boston Board of Fire Underwriters, which will be out of press in a few days, is designed to fill the long felt want of central station men, contractors and constructing engineers. It not only gives all the latest rules, formulæ and tables for alternating and direc current wiring, but also contains twenty full-page illustrations of outside and inside construction as approved by the fire underwriters throughout the United States, as well as the International Insurance Association. Mr. Cushing is booking already some very large orders for it.

Pittsburg Notes.

Fittsburg, Pa., August 25, 1894.

THE SECOND AVENUE TRACTION COMPANY has completed its main line from Braddock to Turtle Creek, which gives the company a direct line of electric railway from Pittsburg to Turtle Creek, a distance of 13 miles.

MR. THOS. I. TRACY, secretary and treasurer of the Electric Appliance Company, Chicago, who is spending his vacation in the East, reports that the Western indications of improvement and a good fall trade are good.

A FIRE broke out last Monday night in the laboratory of the Westinghouse Electric and Manufacturing Company, but apart from a scorching to the furniture and the walls,as well as the loss of some experimental apparatus,the damage was very slight. The fire did not interfere with the operation of the works.

MR. LEON LE PONTOIS, of the draughting department of the Westinghouse Company, was married last Tuesday to Miss Eleanor O. Reed. After the nuptial knot had been tied, the young married pair went on a trip to the southeastern shore of the Atlantic. Mr. Le Pontois is well known in Pittsburg as a lecturer on electrical subjects.

THE SECOND AVENUE TRACTION COMPANY is about to erect a new power house for the operation of its entire lines. The plant will be put up at Glenwood. The contracts for the buildings, the engines, the boilers and the entire electrical equipment have already been let. The Russell Engine Company has secured the contract for the engines, and the generators, amounting to a capacity of 1,800-h. p., will all be furnished by the Westinghouse Electric and Manufacturing Company.

THE MEMBERS OF THE G. A. R. next month will hold their annual encampment in this city, and one of the most interesting features of entertainment provided here for the "boys in blue" will be a grand banquet and reception at the new works of the Westinghouse Electric and Manufacturing Company in Brinton, Pa., near this city. The immense size of these buildings makes them especially suitable for the purpose. At the present time there are about 1,000 workmen occupied in the buildings, getting them in shape for the occasion. Floors are being laid, tables are being put up and seats are being erected. The affair will perhaps be one of the largest receptions that has ever been held anywhere, and it is only owing to the coincidence that the encampment and the completion of these large buildings happens at the same time that this reception is made possible. How many thousands of people will be there cannot be foretold, but arrangements are being made to have 5,000 people sit down to the table at one time. The reception will be held in Machinery Hall, which is a structure 754 feet long and 254 wide. The building will be lighted by 240 arc lights.

Western Notes.

THE CHICAGO GENERAL FIXTURE COMPANY, in addition to its splendid line of electric and combination fixtures, now handles a complete line of electrical supplies.

J. HOLTGATES, one of the busiest individuals in the electrical field, reports unusual success with Mather apparatus and Card street railway motors. Mr. Gates is still in the Monadnock, and is always busy.

THE CHICAGO CROSS ARM COMPANY, with an office at 932 Monadnock building, has made a very good impression with its cross arms made of Georgia pine, which, according to government tests, shows remarkable strength and durability.

THE UNION BRASS MANUFACTURING COMPANY, under the new management of Mr. A. Weinberg, has made decided progress in the introduction of the popular Mosher arc lamps. The new alternating current lamp manufactured by this company is meeting with remarkable success and is being rapidly introduced on alternating systems throughout the country.

THE KNAPP ELECTRICAL WORKS has surprised and pleased its host of friends and customers by issuing a catalogue that will find a place among the finest specimens of trade literature. As a catalogue of electrical goods it could not be improved upon. As a specimen of the printer's art, it is superb. It is well worth having just as a book, to say nothing of its many advantages to those wishing to have at hand a complete encyclopedia of standard electrical specialties and devices.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY last week added to their list of exchanges by equipping one at Cambridge, O., which is pronounced to be the finest telephone system of its extent in the state. One of their recent victories was at La Grange, Ill., where they secured a contract for the complete exchange, and still another is announced by telegraph at Decatur, Ind. The company have just arranged for a registering device which records every call made upon the exchange by the subscriber, which operates on the same lines electrically that gas meters operate mechanically. Its factory is running night and day to keep up with the flood of business that is now upon them.

THE HARRISON INTERNATIONAL TELEPHONE COMPANY, finding it impossible to conduct its business from the New York office, has opened another in the Chamber of Commerce building, Chicago. It has also organized branch companies in eighteen sections of the United States in order to give the business more direct supervision. The company builds plants complete, or electrical companies can purchase their telephones and appurtenances, and do their own construction. The automatic switch offered by this company is creating considerable attention. Manager Hanford is now nicely settled in his new office, and feels confident of an immediate as well as permanent success with the Harrison telephone.

THE WALLACE ELECTRIC COMPANY has added to its present line of specialtes a complete line of arc lamps adapted for almost every purpose. The company is now western agent for the Electric Construction and Supply Company, New York. The "Ward" arc lamps manufactured by this company need no introduction. The Wallace Company will carry a complete stock in Chicago, including alternating, direct current, double carbon and twin lamps, ornamental, plain, railway, search, theatrical and focusing lamps and projectors. The company's house goods department, recently inaugurated, is meeting with success, as that department has already made a record. The Eureka iron box manufactured by this company will be recognized in a new dress, and with its double adjustment features it is now one of the neatest and most serviceable bells on the market. The Ajax dry battery, the Diamond carbon battery, the Excelsior Disque La Clanche battery are all favorites. The company announces that its new illustrated pamphlet will soon be ready for distribution.

ARMOUR INSTITUTE, Chicago, has issued a prospectus of its course in the department of Electricity and Electrical Engineering, of which Prof. Wilber M. Stine, Ph. D., is director. This course extends over four years, and has been designed to be more distinctively electrical than is common with other electrical schools, and aims, by a most thorough training, both in theory and practice, in a great measure to bridge over the hiatus between the school on the one hand and the electrical factory, central station, or usual engineering practice, on the other. Due prominence is given to the idea that a thoroughly trained electrical engineer must be equally well grounded in mechanical and steam engineering and machine-shop practice. The degree to be conferred upon the completion of the full course in electricity is Bachelor of Science in Electrical Engineering. Upon the completion of an additional year of resident post-graduate electrical and mechanical study and testing, or after two years of actual engineering work, the degree of Electrical Engineer will be conferred.

News of the Week.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The Mobile & Spring Hill Railroad Company will improve its road.

HAZELTON, PA.—Southsiders want the trolley extended to Silver Brook Junction.

KEY WEST, FLA.—E. H. Gate has been granted a franchise to convert his street railway into an electrical road.

OXFORD, PA.—It is reported that a preliminary survey will soon be made for the proposed route of the Oxford & Parkesburg Electric Railway.

ASHLAND, MASS.—It is stated that workmen have commenced on the construction of the electric railroad between Ashland and Hopkinton.

KNOXVILLE, TENN.—J. F. Scott and associates have been granted a franchise by the City Council to construct and operate an electric railway.

COLUMBUS, GA.—The Columbus Railroad Company is negotiating for the equipment of its street car and belt, passenger and freight lines by electricity.

LITTLE ROCK, ARK.—Fuller & Moss and H. F. Auten have applied to the City Council for a franchise to build and operate a four-mile electric railway.

ATLANTA, GA.—The Atlanta Consolidated Street Railway Company is equipping its Decatur branch with electricity, and the line will very soon be in operation.

MIDDLETOWN, N. Y.—An electric railway will be built through Benton avenue by the Traction Company, who will begin work immediately to connect its tracks.

POTTSTOWN, PA.—The Pottstown Passenger Railway Company is contemplating the extension of its line from Stowe to the bridge crossing the P. & R. R. at Bramcota,

WHITE PLAINS, N. Y.—A new company is being organized, which proposes to build and operate a trolley road from the Hudson River through the villages of Long Island Sound.

TOWSON, MD.—The extension of the Towson branch of the City and Suburban Electric Railway Company from Towson to Luthervlle, Texas and Cockeysville, is being urged.

MEDIA, PA.—At the meeting of the borough council permission was given the Delaware County & Philadelphia Electric Railway Company to lay tracks on Washington street as far east as Oliver.

BERLIN, CONN.—Work on the Berlin extension of the electric line will begin September 1. H. S. Tuttle, of Lynn, has made a preliminary survey of the proposed route. Bids for the contract will be received at once.

CAMDEN, N. J.—The Camden, Gloucester & Woodbury Electric Railway will be extended from its terminus, at Woodbury, to Pitman Grove, and, perhaps. to Glassboro and Clayton, taking in the towns of Mantua, Wenonah and Sewell.

PLAINFIELD, N. J.—It is reported that the Street Committee of the Common Council and the Plainfield Electric Street Railway have finally settled upon an agreement, and that the extensions to Dunellon and Netherwood will soon be under way.

PHILADELPHIA, PA.—The West Chester & Philadelphia Turnpike Company has procured a charter for an electric railway and trolley from Philadelphia to West Chester, via Newtown square, with a branch line from the latter point to Paoli.

CATOOSA SPRINGS, GA.—J. H. Warner will construct an electric railway from Catoosa Station, on the Western Atlantic Railroad. direct to Catoosa Springs. Surveys of the proposed new line have been made by Major Moe, of Chattanooga, Tenn.

OWING'S MILLS, MD.—A power house for the proposed Pikeville, Reister Town and Emory Grove Electric Railway Company is to be erected at Owing's Mills. John H. Hoffman, of Hagerstown, Md., is president of the company, and may be addressed for information.

REISTERSTOWN, MD.—A public meeting will be held to further the project of building the proposed electric railway from Reisterstown to Union Mills, the connecting link between the Baltimore and Gettysburg systems. Gov. Brown and Dr. J. W. Hering will address the meeting.

ST. AUGUSTINE, FLA.—The City Council has caused a hitch in the negotiations for the electric railway under contemplation there. The franchise has some arbitrary requirements as to which end the road shall be first constructed from, and these requirements the Council has not removed.

BOSTON, MASS.—The Newtonville & Watertown Street Railway Company asks that it may extend its tracks in that part of Boston called Brighton. It also asks for the right to erect the needed poles with overhead wires for the operation of its cars by electricity. Horace B. Parker is president.

MONTCLAIR, N. J.—It is rumored that within a short time a conference between the township committees of Bloomfield, Caldwell and Verona, and the town council of Montclair, will be held to discuss the question of establishing a trolley road, and to decide whether it would be advisable to grant a franchise.

CRAWFORDSVILLE, IND.—Upon the application of H. J. Clodfeller, A. N. Painter, of Alexandria, and V. C. Quick, of the same city, representing a company of Indiana capitalists, the Madison county commissioners granted a franchise for an electric line through this county. It will be known as the Indiana Gas-Belt Electric Line.

OSWEGO, N. Y.—At the Common Council meeting, the petition of Maitland E. Graves for a franchise and permission to build and maintain a street railway, with necessary switches and turnouts, in East Ninth street, or East Tenth street and along Mitchell street to St. Paul's cemetary, was referred to the Committee on Streets and the city attorney.

HACKENSACK, N. J.—The question of building a trolley line at Hackensack was informally considered by the local authorities at a recent meeting of the Improvement Commission. The matter came up on the presentation by Commissioner Eckerson of the plans and specifications under F. H. Chinnock, who agrees to build and equip a trolley system in the town.

DOYLESTOWN, PA.—The Bucks County Railway Company has been incorporated, the line of which will run through the principal streets of Doylestown, and from Doylestown to Centreville and Newtown. Capital, $100,000. Incorporators: F. Fenimore, S. Savids, W. Jenks, F. Marshall, S. Lynch, S. A. Hamilton and Robert C. Fulton, Philadelphia.

TAMAQUA, PA.—The Tamaqua & Pottsville Electric Railway Company, whose charters cover territory from Tamaqua to Pottsville, via Middleport, New Philadelphia and Port Carbon, has filed a declaration of its intention to extend its main line from Port Carbon to St. Clair, and thence to New Castle and Frankville and down to Maizeville, in the Mahanoy Valley.

POTTSVILLE, PA.—S. B. Edwards, solicitor of the Pottsville, St. Clair & Minersville Electric Railway, stated that the company will be ready to commence building its road immediately after the Borough Council shall have given it the right of way to occupy certain streets. The road is to be 10 miles long and there is a capital of $150,000 to back it. Wilbur S. Sadler, of Carlisle, is president.

EAST STROUDSBURG, PA.—The new electric railway from East Stroudsburg to Bushkill has let the contract for the rails, and proposals are asked for furnishing 40,000 chestnut ties. Should the East Stroudsburg council refuse to meet the company on a fair basis they will run into that place over the tracks of the Delaware, Lackawanna & Western Railroad, which has been offered them.

BRIDGETON, N. J.—The contract for building the power house of the South Jersey Traction Company, in South Bridgeton, has been awarded to the Cumberland Construction Company, who was the lowest bidder. The equipment will consist of two 150 h. p. Corliss engines, two 100-kw. generators, with necessary boilers, switchboards and appliances, and will cost nearly $30,000 in all.

CONSHOHOCKEN, PA.—The Conshohocken Railway Company has purchased the right of way from the Plymouth & Whitemarsh Turnpike Company over the whole length of the road from the Schuylkill River to Plymouth Meeting. Mr. Shopp said that the company intends to give out the contract immediately for the building of the line through Conshohocken, and would push it to completion.

AMBLER, PA.—The announcement is made that a syndicate of Philadelphia capitalists has secured control of the stock of the Chestnut Hill and Spring House Turnpike Company, and contemplates the construction of a trolley line over the turnpike from Chestnut Hill to Ambler. Another line that may be built in the near future is an extension of the Norristown and Conshocken trolley line to Ambler.

IOWA CITY, IA.—Messrs. Seevers, of the Muscatine Electric Railway, are contemplating building an electric car line in Iowa City, and probably will do so if negotiations now in progress reach a successful conclusion. The plan is to purchase the gas plant, for which $65,000 has been offered, and build ten miles of track, which they promise to have in operation in 60 days after the council has granted the franchise.

MIDDLETOWN, CONN.—Work is soon to begin on the proposed system of electric railroads. The representatives of the New England Construction Company, which is to build the roads, have had their engineers here, and the work of surveying the route has been commenced. The new road to Meriden, it is expected, will be built in the spring. The lines in this city will be completed by the early part of the spring.

MILWAUKEE, WIS.—At the meeting of the Common Council a resolution was adopted authorizing the commencement of negotiations for the purchase of the property of the Milwaukee Street Railway Company, which includes not only all the street railway lines in the city, but also the plants formerly controlled by the corporations known as the Badger Illuminating Company and the Edison Electric Light and Power Company.

NANTICOKE, PA.—The News Dealer is authority for the statement that a New York brokerage firm has issued prospectuses for the promotion of an electric railway company to operate between Nanticoke and Berwick. The intention is to extend the line to Nanticoke. The proprietors expect to bond the road for $1,500,000. The company expects to build 23 miles of road. The Johnsons, of Cleveland, are said to be back of the enterprise.

OREGON CITY, ORE.—The Council is considering the granting of a franchise to a company to build an electric railway along certain streets from the top of the bluff out to the city limits. A committee has practically agreed upon an ordinance which will be reported. This company, in which is included John Myers, of Portland, states that it intends to prosecute the work as fast as possible, beginning within a month after it secures the franchise.

ELKHART, IND.—A big mortgage has been filed by the Indiana Electric Railway Company to secure the payment of bonds of the company, which may be issued to the amount of $50,000 for the construction, extension and improvement of the lines of street railway in Elkhart and Goshen, and the intersuburban lines. The work will be rapidly prosecuted. It is estimated that the lines in the two cities will cost $10,000 per mile, and one-half that much outside of town.

ANNAPOLIS, MD.—A special meeting of the city council met to consider the granting of a franchise to the Annapolis, Brighton Beach & Bay Ridge Electric Railway, for the use of the streets of Annapolis. The proposed company was represented by Messrs. George T. Melvin and James R. Branshears, two of the incorporators. Nothing definite was settled, although the committee is favorable to granting the privilege when the company complies with all the requirements.

HARRISBURG, PA.—Preparations are being made by the Cumberland Valley Traction Company to begin work on the construction of the electric railway from Harrisburg to Carlisle via Mechanicsburg. J. W. Brown & Co., of Harrisburg, have been notified to prepare the iron work for the strengthening of the bridge. The track will be laid on Walnut street and then over the bridge. The road from Harrisburg to Mechanicsburg is now within sight and the prospects are bright for its construction.

PIKESVILLE, MD.—An electric line between Randallstown and this place is contemplated. A committee consisting of Edward S. W. Choate, Dr. Henry J.

Hebb and others, representing the directors of the Randallstown, Harrisonville and Granite Rapid Transit Company, called upon Jos. T. Floyd, agent in Baltimore of the Barrow Electric Railway system, and made the proposition that the Northern syndicate, represented by Mr. Floyd, co-operate with the local people in the construction of the road. The proposition was accepted.

SAN FRANCISCO, CAL.—An electric road from Merced to the Yosemite is proposed. These surveys have been made and other details have been arranged. It will move passengers and freight. The length will be sixty-two miles, following the course of the Merced River much of the way. The power will be secured from a dam already constructed at Merced Falls. It is proposed to furnish power to Merced for electric lighting and manufacturing purposes. G. A. Walkup, at the Palace Hotel, San Francisco, is proprietor.

RED BANK, N. J.—The Monmouth Electric Traction Company has filed its certificate of incorporation in the office of clerk of Freehold. The incorporators are Wm. W. Coniver, Daniel H. Applegate, Charles B. Parsons, J. Enright, Jr., Wm. T. Parker, R. Avery, J. W. Robinson and others. The capital stock is $300,000, and it is proposed to build and equip a street railroad from Red Bank to Long Branch and return. The central power plant will be located at Red Bank. In all probability this company will build a road between Red Bank and Seabright.

EAST MILTON, MASS.—A company is being formed at Milton for the purpose of constructing and operating an electric street railway between East Milton and Mattapan. The corporation will be known as the Milton & Boston Street Railway Company, and will have a capital stock of $50,000. The road will be four miles long and will connect at Mattapan with the Dedham Street Railway. The directors are A. A. Brackett, J. R. Lawrence, D. J. Brown, W. H. Rice, of Milton, and J. A. Duggan, T. H. McDonald, and W. P. Pinel, of Quincy. Another new line will be one to Nantasket Beach, over the line to Quincy Point, thence to Nantasket by the Quincy & Nantasket Steamboat line.

NIAGARA FALLS.—The Niagara Falls and Port Dalhousie Electric Railway Company are applying for a charter for the purpose of constructing and working a street railway from Niagara Falls to Port Dalhousie, and passing through the intervening muncipalities of Stamford, Thorold, Merritton, St. Catherine and Grantham. The capital stock of the company is to consist of $300,000. The applicants for incorporation are: Lany Lundy, of Niagara Falls; William J. West, Niagara Falls; Jay Schooley, of Welland; Alexander Nelson, Thomas Home and James Pearson, Toronto, all of whom are to be the first directors of the company.

WEYMOUTH, MASS.—An electric railway from Shaw's Corner, East Weymouth, through Weymouth and East Braintree to the station of the N. Y., N. H. & Hartford Railroad at Braintree, is projected. A company is to be organized and active steps taken to secure franchises from the Weymouth and Braintree authorities. A large amount of stock has already been taken. Among those interested are the following: Representative John Kelley, of Braintree; Judge James H. Flint, of Weymouth; Francis Ambler, F. L. King, E. W. Hunt, J. F. Sheppard, F. A. Sulis, H. F. Perry, C. T. Bailey and J. W. Carey. The road will probably be running by the last of October.

Electric Light and Power.

NEWTON FALLS, O.—A movement is on foot to establish an electric light plant.

PORT ARTHUR, CAN.—The electric light plant of the town was destroyed by fire.

CROWLEY, LA.—Address the Mayor concerning the electric light plant to be constructed.

OXFORD, MISS.—Address E. O. Davison concerning a proposed electric light plant.

SAN DIEGO, CAL.—Address the Mayor concerning an electric light plant to be constructed.

ALLEGAN, MICH.—The citizens have under consideration the question of municipal lighting.

LOCKHART, TEX.—The Lockhart Electric Light Company is about to build an electric light plant.

HENDERSON, MINN.—Address the Mayor regarding contract for establishing an electric light plant.

WESTFIELD, MASS.—The W. Warren Thread Works is in the market for a 250-light electric light plant.

LANCASTER, O.—Address C. D. Hills regarding an electric lighting plant for the Boys' Industrial School.

TOPEKA, KAN.—Address H. W. Farnsworth concerning an electric light plant for the High School building.

ALEXANDRIA, LA.—A. B. Rachol, acting mayor of Alexandria, will advertise for bids for an electric light plant.

OTSEGO, MICH.—George C. and B. E. Nevins are to establish an electric light plant, and are in the market for its equipment.

HOT SPRINGS, ARK.—The Hot Springs Electric Light Company is contemplating putting in a 1,500 lt. alternating machine.

PHILADELPHIA, PA.—Alterations, embracing an electric light plant, to cost about $50,000, are to be made to the Continental Hotel.

NEW ORLEANS, LA.—R. L. Schroeder will give information regarding the electric light plant to be installed at the Government Mint.

OXFORD, MISS.—Address the secretary of the Young Men's Business League concerning the establishment of an electric plant contemplated.

INDEPENDENCE, ORE.—The Independence Water & Electric Light Company has been succeeded by the Gilmore Electric Light & Power Company, incorporated.

Personal Notes.

MR. PHILIP DAWSON, of London, England, is on a visit of inspection to the United States with a special view of examining into American methods of street railway equipment and working, of which he will furnish an account in the columns of London "Engineering." Mr. Dawson was formerly asssociated with the late A. Reckenzaun, and more recently, as a partner, has been with Mr. R. W. Blackwell, 39 Victoria street, London, formerly president of the Buckley-Knight Company, in this country, and a brother of F. O. Blackwell, of the General Electric Company, and of J. L. Blackwell, consulting engineer, of Baltimore. The firm, in addition to its consulting work, has the sale of various electrical specialties, more especially for electric railway work, and has sold most of the railway material thus far used in England, and a considerable quantity on the Continent.

MR. J. W. OLAN, the subject of this sketch, whose name is familiar to the electrical profession through his contributions to discussions in the Transactions of the American Institute of Electrical Engineers, was born in Sweden.

J. W. OLAN.

After four years of training at the Elementary State School and seven years spent in classical studies, he was graduated from the Superior College at Gothenburg, and entered in 1875 the philosophical faculty of the University of Upsala. Pursuing studies in mathematics, natural sciences and languages, Mr. Olan later went to the south of Europe and attended courses at the universities in Geneva, Paris, and various other places. Returning to Sweden he finished his studies at the Polytechnicum, in Stockholm, and adopted mining engineering as a profession. He took an active part in the installation of the Swedish section of the International Electrical Exhibition in Paris, 1881, during which year he entered into Edison's service and worked at the International Electrical Exhibition in London, 1881-1882. After a contract with the Edison Foreign Electric Light Co., Mr. Olan went, in 1882, to Sweden as superintending electrical engineer to undertake the pioneer work for the incandescent light in that country, and remained there until the Edison patent was annulled by the Swedish Government. Mr. Olan came to the United States in 1890, and has devoted the last several years to inventions, one of the most recent of which, the Olan Recorder, we describe elsewhere in this issue.

Trade and Industrial Notes.

THE BROWN & SHARPE MANUFACTURING CO., and DARLING, BROWN & SHARPE, Providence. R. I., resumed work in all departments of their establishments at the close of their annual vacation, Monday, August 20.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, O., has arranged its course in advanced mathematics so that it now includes algebra and geometry, trigonometry, analytical geometry and differential and integral calculus.

THE WATERTOWN ENGINE COMPANY, Watertown, N. Y, has at present as large a force engaged upon electric light engines as at any time since it commenced building them, and is compelled to work nights in order to fill some very urgent contracts.

THE HUBLEY MANUFACTURING CO., Lancaster, Pa., which manufactures complete equipments for electric railway and lighting plants, is at present doubling the capacity of its works to accommodate the enormous increase in the demand for its apparatus.

MESSRS. H. B. COHO & CO. report the sale this week of Mather generators to the E. P. Gleason Manufacturing Company, and to Mr. Henry Reinhard, eighty-sixth Sreet and Third Avenue. This is the second machine they have installed to Mr. Reinhard this summer.

THE MORGAN ENGINEERING COMPANY, Alliance, O., will supply to Jones & Laughlin, of Pittsburg, who are constructing a new roll shop in connection with their mills, one of its standard construction traveling cranes, all motions of which are operated by electric motors. The lifting capacity of the crane is 15 tons, and the span about 40 feet.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been experiencing a very satisfactory trade during the month on its two-wire specialties, Paranite rubber covered, for inside work, and "O. K." weatherproof, for line work. Numerous large orders have been received, and coming as they do so early in the season, certainly promise well for a handsome fall trade.

WARREN WEBSTER, of Warren Webster & Co., Camden, N. J., has been awarded a patent for a feed-water heater and purifier, which obviates the necessity of requiring steam to enter such apparatus at a pressure in excess of that of the atmosphere in order to get rid of air which at times accumulates in the top of the chamber and renders the apparatus useless until expelled.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has issued a 16-page catalogue devoted to multi-polar generators and motors. Illustrations are given of 45 kw. and 11¼ kw. machines, and of the type of armature used, both wound and unwound. A wire formula and table are given for 100 and 500 volt circuits, which will be found useful by the electrician,

THE DODGE MANUFACTURING COMPANY, Mishawaka, Ind., has issued a 200-page duodecimo catalogue, "B 4," of appliances for the transmission of power. Numerous illustrations and lists are given of wood pulleys, shafting and shafting fittings, clutches, etc. An interesting section is that devoted to rope transmission, from which the engineer may derive much information.

R. F. DOWNING & COMPANY, customs and forwarding agents, Corn Exchange Bank, New York, make a specialty of attending to electrical importations. With branches at London, Liverpool, Glasgow, Paris, Hamburg and Bremen, they have unusual facilities for accepting delivery of goods direct from the manufacturers and forwarding them under advantageous conditions, as well as passing them through the custom house expeditiously.

THE HOPPES MANUFACTURING COMPANY, g eld, O., are now

busily engaged installing four of its live steam feed-water purifiers, of 3,000 horse-power total capacity, in the new electric station of the Lindell Railway Company, at St. Louis, Mo. The Hoppes Company feels somewhat elated over this contract, as it was only secured after a hard fight, and in the face of very strong competition. Among other recent sales to electrical companies we note the following: Live steam feed-water purifiers of 1,500 h. p. to The Indianapolis (Ind.) Light & Power Co., and 150 h. p. to The Cincinnati (O.) Street Railway Co.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., have received the contract for the new plant of the Fairfield Copper Company, at Monroe, Conn. The plant will be entirely of iron and steel, no woodwork being used about the construction. The new power station for the Hartford Street Railway Company, at Hartford, Conn., will be designed and built by the same company. It will be 66 feet wide and 233 feet in length, with a steel frame covered with anti-coudensation corrugated iron covering. When completed it will be one of the most complete stations of the kind in the country, and will be absolutely fire-proof.

THE AMERICAN ELECTRICAL COMPANY, St. Louis, Mo., sends us a handsome pamphlet with its imprint, entitled, "St. Louis, 1894." The brochure is profusely illustrated with views of notable streets and public, office and manufacturing buildings, and also of the parks, gardens and monuments with which the city is embellished. The descriptive matter deals thoroughly with all the various public and private interests that give the city standing. We learn from a table that the number of the electrical workers is rated at 500, which is doubtless an understatement if those employed in lighting and power stations are included.

"REORGANIZATION SALE," QUEEN& CO., incorporated, of Philadelphia, inform us that in order to effect a nearly and satisfactory reorganization of their company, it is considered necessary to make a prompt reduction in merchandise stock, and in this connection particularly call attention to their standard electrical instruments, such as "magnetic vane" switch-board volt meters and ammeters, Deprez-Carpentier portable volt meters and ammeters, Cardew standard voltmeters, electro dynamometers, milli-ammeters, portable astastic snd d'Arsonval galvanometers, "Acme" and "Decade" portable testing sets, silver chloride testing batteries, portable photometers, etc.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., are now represented on the Pacific Coast by the following contractors for their apparatus: H. B. Gregory & Co., Portland, Ore.; The Will & Finck Co., San Francisco, Cal. The Machinery Supply Co., Los Angeles, Cal. It also reports the closing of an important contract with the Phelps Publishing Co., of Springfield, Mass., publishers of "The Springfield Homestead," "The American Agriculturist," "The Farm and Home," etc., for the complete equipment of their extensive plant with electric power. The new slow speed motors of The Mather Company will be used throughout in sizes from 20 to 50 h. p. the power being supplied from the Springfield station of the United Electric Light Company. This installation, when completed, will be one of the largest of its kind in New England.

TAYLOR & CLARK, 510 Arch street, Philadelphia, Pa., the well-known supply house, have decided to enter the manufacturing field, making a specialty of knife switches and switchboards of every description. Their present factory, located at Fifty-second street and Lancaster avenue, has been fully equipped for the rapid production of all classes of electrical work, including the making of storage batteries and the rewinding of motors and dynamos.

THE LANCASTER RAILWAY CONSTRUCTION COMPANY, Lancaster, Pa., has been awarded a contract by the Pennsylvania Traction Company, for building twenty-three miles of electric railway in Lancaster county. The line will run from Lancaster to Manheim, Lancaster to Mechanicsburg, New Holland, Blue Ball and Terre Hill, with an eight-mile branch from Mechanicsburg to Ephrata. The specifications call for Pennsylvania Railroad standard construction, including switch and signal system. The overhead construction and all equipment will be of the highest grade, and must be completed, ready for service, within ninety days. The Lancaster Railway Construction Company is a chartered corporation with the following officers: Henry Bumgardner, president; Michael Reilly, vice-president; F. H. Steacy, secretary; J. E. Hubley, treasurer, and H. E. Crilly, superintendent of construction.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A RARE BUSINESS OPENING is offered to any one wishing a safe and profitable investment by N. J. Busby, 8 Medford street, Boston, who has for sale a number of live and valuable patents for mechanical bells. The sale is rendered necessary by the precarious state of the inventor's health. See advertisement on page xxxi.

OPEN AND CLOSED CIRCUIT CELLS.—The Hayden carbon porous cup No. 1; the Hayden carbon porous cup No. 2 cell; a Leclanche clay porous cup cell; a standard Fuller cell; a No. 2 Fuller cell; a single cylinder carbon cell; a double cylinder carbon cell. All reliable and efficient, and at prices lower than ever. THE HAYDEN-BOOKER MANUFACTURING COMPANY, 2140 DeKalb street, St. Louis, Mo.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 21, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.

524,983. APPARATUS FOR SUPPLYING ELECTRICITY FOR LIGHT AND POWER PURPOSES; Milton M. Kohn, Chicago, Ill. Application filed September 24, 1891. The combination with an electric battery comprising a number of cells electrically connected in series, of means for cutting out old cells and simultaneously cutting in new cells to keep the strength of the battery constant, and means for preventing short circuiting of the cells.

524,981. ELECTRIC-ARC LAMP; Rudolf Hermann Jahr, Opladen, Germany. Application filed April 19, 1894. The combination, in an electric arc lamp, of a horse-shoe electro-magnet having two adjacent poles of like name, an armature placed with one end between said poles and mounted so as to be capable of oscillation in a horizontal plane, a winding placed in the main circuit of the lamp for exciting one of the said poles, and a winding placed in a derivation to the luminous arc for exciting the other one of said poles.

524,980. ELECTRIC WIRE COUPLING; Charles K. Hall and William B. Lillard, New Orleans, La. Application filed December 8, 1893. In an electric wire coupler, the combination with two wires insulated from each other; of a hollow metal coupler head having one of the wires electrically connected thereto; a metallic spring plunger mounted in said coupler head and insulated therefrom, the second wire being electrically connected to said plunger, and an electrical conductor extending from said plunger toward the side of said coupler head and adapted to complete the circuit when said plunger is pressed forward.

524,977. UNDERGROUND CONDUIT FOR ELECTRICAL CONDUCTORS; James F. Cummings, Detroit, Mich. Application filed January 17, 1893. An underground conduit for electric conductors, consisting of a series of tubes divided longitudinally and arranged with their ends overlapping, spirally wound binders for the tubes arranged at intervals.

524,976. ELECTRIC RAILWAY SUPPLY SYSTEM; James F. Cummings, Detroit, Mich. Application filed September 22, 1892. In an electric power system for railways, the combination with two insulated supply conductors, two distributing conductors divided into sections independently connected by feeders to main supply conductors, of a switch at a central station having contacts connected by independent test lines with the sections of the distributing conductor, an independent source of electricity having one terminal connected to the movable contact of the switch and the other to the ground, and an electric indicating device in circuit with said source of electricity.

524,973. FIRE ALARM SYSTEM; Joel Wales White, Providence, R. I. Application filed May 28, 1894. A fire alarm system comprising a closed circuit containing a resistance and translating device, an open circuit containing a translating device, a the mostatc having three electrodes, a shunt around the resistance closed by two or three thermostatic electrodes, and the open circuit arranged for closure by the third thermostatic electrode.

524,847. ELECTRIC DANGER SIGNAL FOR RAILWAYS; Archibald B. Murray, San Rafael, Cal. Application filed March 17, 1893. In an electrical signalling and alarm system for railways, a closed main circuit in the engine including as part of it the armature, a magnet and a circuit breaking trip lever; an obstruction on the track, a circuit breaker at a relatively distant point electrically connected to a rail and to the said obstruction, and positively operated by the movement of said rail, and another magnet in the engine having a bell-sounding armature and in open circuit with the battery, all arranged so that in case the main circuit is broken at both trip-lever and distant point, the armature will close an independent bell circuit on the engine.

524,845. AUTOMATIC REGULATOR FOR DYNAMOS; Henry D. Symmes, St. Catharines, Canada. Application filed June 6, 1894. In an automatic electric regulator for dynamos, two or more solenoids arranged in series as regards the main circuit, and in multiple arc as regards one another in combination with two or more resistance circuits connecting the positive and negative wires of the main circuit, each having a contact therein and each solenoid being arranged to break its corresponding resistance circuit when a current of more than a pre-determined number of amperes passes through the main circuit.

524,850. INSULATOR; Charles N. Hammond, Boston, Mass. Application filed December 18, 1893. An insulator comprising a mass or block of suitable material formed with a wire-receiving groove or depression and holes on opposite sides of such grooves or depression, a wire retainer having a stem which is placed in one of said holes and a hook-shaped head which overlies the wire in the groove or depression and has its own down-turned point entered into the other of the said holes, and a securing device applied to the said stem.

524,881. ELECTRIC HEATER; Tapley W. Young, Washington, D. C. Application filed October 6, 1893. An electric heater comprising a water-tight case having an insulated chamber at each end, a metal core having insulated bores packed with a suitable resistant material arranged within the case, between the insulated chambers, binding posts located in said chambers, electrical conductors attached to said binding posts and extending within the core, electrodes attached to said conductors, electrical connections between the bores in the core, and means for passing a current of electricity to the binding posts.

524,884. COMMUTATOR FOR DYNAMO: ELECTRIC MACHINES; George F. Card, Covington, Ky. Application filed January 8, 1894. In a commutator, the combination with the armature shaft, of cap-plates mounted hereon, a series of segments carried by the cap-plates, and a packing interposed between said plates.

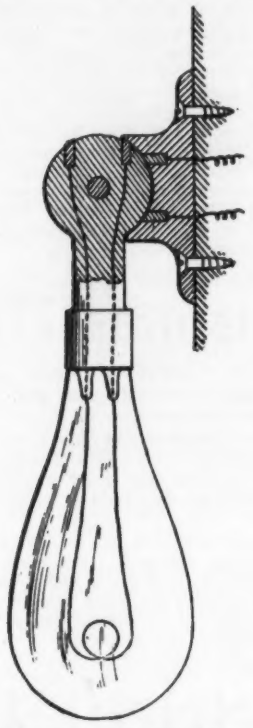
524,911. APPARATUS FOR TRANSFORMING CONTINUOUS ELECTRIC CURRENTS INTO ALTERNATING CURRENTS; Franz Sevirin Ferdinand Schneider, Fulda, Germany. Application filed March 20, 1894. In a transformer, the combination with two electromagnets included in two primary circuits and a battery common to both circuits, of a rocking armature carrying contacts operating to alternately make and break said circuits, and a secondary conductor having its terminals connected with the primary circuits between the magnets and the circuit breakers.

524,844. ELECTRICAL TESTING SWITCH: Henry Smith, Buffalo, N. Y. Application filed March 29, 1894. Consists of a simple and compact arrangement of binding posts, contact buttons and switch-lever so placed upon a switchboard as to enable the operator to ground the circuit either to the right or left of the stations at which it is placed, or cut out the station entirely if desired.

524,823. ELECTRIC RAILWAY CAR; John C. Henry, Westfield, N. J. Application filed August 27, 1892. An electric car comprising a swiveling truck

at one end, and at the other a motor, a single pair of wheels having their axle journaled in one end of the motor frame,a rigid tongue fastened to the other end of the motor and flexibly attached to the swiveling truck, and a car body supported at one end on the frame of the motor at a point in the rear of the single axle.

524,711. PRINTING TELEGRAPH; Robert A. Fowden, Philadelphia, Pa. Application filed December 22, 1893. In a printing telegraph system, a printing circuit, an electric motor, and a vibrating mechanical and centrijugal acting circuit closer and breaker operating to close and interrupt said circuit.

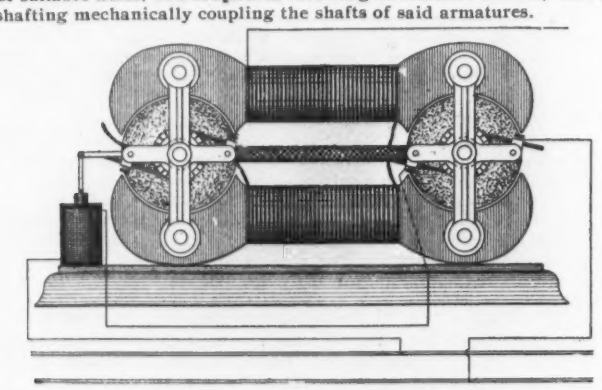


No. 524,706.—ELECTRIC LIGHT SUPPORT.

524,710. METHOD OF PRODUCING ELECTRODES; Desmond Gerald Fitz-Gerald, London, England. Application filed November 7, 1893. The process of manufacturing battery electrodes which consists in treating one or more of the lower oxides of lead with an alkaline hydrate, converting the caustic alkali into carbonated alkali by exposure to carbonic acid, and treating the resulting mass with a solution of sulphate of magnesia.

524,706. ELECTRIC LIGHT SUPPORT; William H. Connell, Wilmington, Del. Application filed January 21, 1894. The combination with a bracket, of an arm pivoted on and supported entirely by said bracket, an incandescent electric lamp secured to the end of the arm so that the pivotal axis of the arm and the axis of the lamp are out of line with each other, an electric circuit leading to said lamp and contact points operated by the swinging of the lamp carrying arm for closing said circuit at a definite point in the travel of the lamp.

524,852. MOTOR GENERATOR; John C. Henry, Westfield, N. J. Application filed December 18, 1891. In an electro-magnetic machine, the combination of suitable fields, two armatures revolving in relation thereto, and flexible shafting mechanically coupling the shafts of said armatures.



No. 524,852.—MOTOR-GENERATOR.

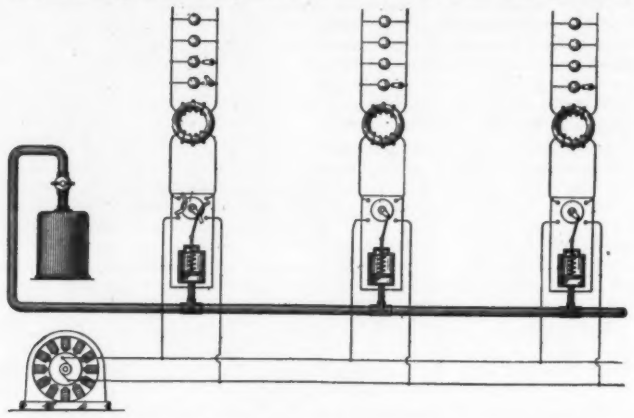
524,953. ELECTRIC METER; Carl Daniel Raab, Kaiserslautern, Germany. Application filed January 18, 1894. An electric motor meter comprising the revolving armature having the coils in a shunt, the damping disks adjacent to the armature, the stations coils and conductors and the mica disks interposed between the armature and the damping disks wherebythe air damping will be reduced.

524,749. SYSTEM OF ELECTRICAL DISTRIBUTION; George Westinghouse, Jr., Pittsburgh, Pa. The combination with a series of electric converters and a circuit for supplying the primary coils thereof, of circuit-controlling devices applied to the respective primary coils for opening and closing the circuit connections thereof, and fluid pressure devices for operating said circuit controlling devices.

524,717. SAFETY SWITCH FOR HIGH POTENTIAL CIRCUITS; Samuel Harris, Cleveland, O. Application filed June 14, 1894. The combination of a non-conducting disk, a single contact-block on each side of said disk at diametrically opposite points with connections to the circuit, a rotating stem extending through the disk and having on each side thereof and diametrically opposite each other a contact arm adapted to make circuit with the contact blocks, said contact arms being conductively connected and rotating in planes parallel to the disk, and an index or handle on said stem for operating the switch.

524,758. ELECTRICAL RAILWAY SIGNAL; Lawrence Dornberger, Highland Falls, N. Y. Application filed April 17, 1894. In a railway signal, the combination with the signal arm; of automatically operated gear devices connected with the said signal arm for adjusting the same, a stop wheel mounted on one of the shafts of the gearing, a catch-pawl for said stop wheel, a trip lever to disengage said pawl from the stop wheel, and an electrically controlled catch for said trip lever.

524,773. ELECTRIC RAILWAY SUPPLY SYSTEM; Malone Wheless, Washington, D. C. Application filed July 7, 1894. Involves the use of contact pins with which the terminal of feeders from the main cable and which are placed at intervals in the track or roadway upon which the car runs, these contacts being successively met by a shoe on the car through which the



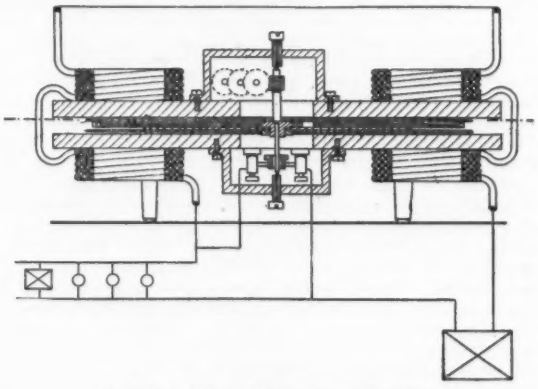
No. 524,749.—SYSTEM OF ELECTRICAL DISTRIBUTION.

current is led to the motor. Each feeder connection has in it normally open contacts which are controlled by a pick up magnet located at that point; this pick-up magnet, although located in the track, being energized from a source of electrical supply on the car through suitable circuit connections.

524,785. CONTROLLER FOR ELECTRIC CARS; Marion Baker Monroe, New Orleans, La. Application filed February 28, 1894. In an electric car, the combination of a motor, a source of electric supply, a rheostat arranged in an electric circuit between the source of supply and the motor, a vertically movable plunger arranged in the electric circuit and contacting with the rheostat, and a suitable means for moving the said plunger.

524,789. ELECTRICAL SUBWAY SYSTEM; John C. Reilly, Brooklyn, N. Y. Application filed May 28, 1894. The combination of an iron subway pipe, manholes at suitable intervals, a slotted tube upon the interior of said pipe with drawing-in devices extending without interruption from manhole to manhole, and a series of five-way couplings interposed in the main duct between manholes, connected with tubes for branch conductors and a vertical tube extending to the surface of the street.

524,793. COMMUTATOR CYLINDER; Alton J. Shaw, Muskegon, Mich. Application filed June 7, 1894. In a commutator, the combination with the conducting bars, of collars at the ends of said bars, one or both of said collars being formed of resilient material and adapted to yield under the pressure due to longitudinal expansion of the bars.



No. 524,953.—ELECTRIC METER.

524,808. CIRCUIT CONTROLLER; Edward J. McEvoy, New York, N. Y. Application filed July 7, 1894. The combination to form a circuit-controller—of a box or casing—a pair of terminals provided with bindng posts, a rotating rock shaft mounted in said box or casing, a yoke of conducting material carried by said shaft, a spring the operation of which is to hold the yoke out of contact with the terminals, an operating shaft journaled within the casing and projecting therefrom, a cam upon and rotating with said operating shaft, and a cam toe springing from the rock shaft and bearing upon the cam.

524,843. SEPARATOR FOR BATTERY PLATES; William L. Silvey, Dayton, O. Application filed February 12, 1894. A battery separating plate consisting of a porous fabric having notched passageways in its edges, the edge of the plate only combined with a preservative material.